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Total No. of Pages: 03
Total No. of Questions: 09

B. Tech.(EE, ECG, ETE) (Sem.-4th)

ELECTROMAGNETIC AND ANTENNAS

Subject Code: BTEC-403
Paper ID: [A1191]

Time: 3 Hrs. Max. Marks: 60

INSTRUCTIONS TO CANDIDATE:

1. *Section-A is compulsory.*
2. *Section-B Attempt any four questions.*
3. *Section-C Attempt any two questions.*

SECTION-A

10x2=20

Q. 1. Answer the following question:

(a) Give the physical interpretation of group and phase velocity in relation to speed of light.

(b) Show that the TM_{01} mode in a rectangular waveguide does not exist?

(c) The VSWR of a lossless transmission line is 5. Find the magnitude of reflection coefficient.

(d) What is the highest frequency that will be returned to earth 1000km from the transmitter by the E layer.

(e) Two isotropic antennas are separated by a distance of two wavelengths. If both the antennas are fed with currents of opposite phase and magnitude find the number of lobe in the radiation pattern in the horizontal plane.

(f) Consider a lossless antenna with a directive gain of +6dB. If 1 mW of power is fed to it. Find the total power radiated by the antenna.

(g) Distinguish between far field and near field.

(h) Which propagation will aid the following frequencies and why. (a) 120KHz. (b) 30 GHz.

(i) Calculate the critical frequency for a medium at which the wave reflects if the maximum electron density is 1.24×10^6 electrons/cm^3.

(j) A radio station radiates a total power of 10 KW and a gain of 30. Find the field intensity at a distance of 100Km from the antenna. Assume free space propagation.

Section-B

4x5=20

Q.2. Discuss the reflection plane waves by a dielectric for oblique incidence. Find the expressions for transmission and reflection coefficient for both horizontal and vertical polarizations. What is Brewster reflection?

Q.3. Derive fields for TE wave in parallel plate waveguide. Derive the cut off frequency for TE guided modes.

Q. 4. Prove that maximum useable frequency for ionospheric propagation is given by MUF=f_c Sec(ϕ), were f_c is the critical frequency and ϕ is the angle with which e.m waves strike ionospheric layer w.r.t to normal.

Q. 5. Calculate the directivity of a unidirectional antenna if the normalized radiation pattern is given by

(i) $P_n = \cos^2(\theta)$

(ii) $P_n = \cos^3(\theta)$

In all these cases the patterns are unidirectional with P_n having value only for $0 \leq \theta \leq 90^0$ and $P_n=0$ for $90^0 \leq \theta \leq 180^0$. The patterns are independent of angleϕ.

Q. 6. (a) An ideal lossless line transmission line characteristics impedance Z_0=60 ohms is connected to unknown load Z_L. If VSWR = 4. Find the Z_L, reflection coefficient and transmission coefficient.

(b) What is field equivalence principle? How it is applied to aperture antennas.

Section-C

2x10=20

Q. 7. (a) A high frequency link is to be established between two points at a distance of 2500 Km on earth's surface. Considering ionospheric height to be 200 Km and its critical frequency 5MHz, calculate the MUF for the given path.

(b) Explain skip distance and virtual height.

Q. 8. Design a Dolph Tchebyscheff broadside array of 10 elements with spacing d between elements and with a major to minor lobe ratio of 26dB. Calculate the excitation coefficients and form the array factor.

Q. 9. A linear thin dipole of length λ is placed symmetrically along z-axis. Find far field electric and magnetic components radiated by dipole whose current distribution can be approximated by

$$I_z(z) = I_0(1+\frac{2}{\ell}z) \qquad -\frac{\ell}{2} \le z \le 0$$

$$= I_0(1-\frac{2}{\ell}z) \qquad 0 \le z \le \frac{\ell}{2}$$

Also find the radiation resistance of the dipole.

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