Total number of printed pages–4

53 (EC 710) ANWP

2021

ANTENNA AND WAVE PROPAGATION

Paper : EC 710

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions :* 20×5=100

1. 2+8+3+7=20

(a) What does input impedance mean ?

(b) Deducing the necessary equations, show that power supplied by the generator to a radiating antenna is the summation of power radiation through radiation resistance, power dissipated as heat in loss resistance of the antenna and power dissipated in the internal resistance of the generator.

Contd.

(c) What is the radiation resistance of an antenna ? How does it vary with length of the antenna and frequency of operation ?

(d) Derive the Friis transmission equation

$$\frac{P_r}{P_t} = e_{cdt}\, e_{cdr} \left(1 - |\Gamma_t|^2\right)\left(1 - |\Gamma_r|^2\right)\left(\frac{\lambda}{4\pi R}\right)^2 D_t(\theta_t, \phi_t)\, D_r(\theta_r, \phi_r)\, |\hat{\rho}_t \cdot \hat{\rho}_r|^2$$

where the symbols have their usual meanings.

2. (2+3)+15=20

(a) What are auxiliary potential functions ? Why are they used to find the radiation fields ?

(b) Derive the expressions of radiation fields E and H using auxiliary functions.

3. (4+4+4)+(4+4)=20

(a) Deduce the expression of magnetic vector potential due to current element of an infinitesimal dipole *i.e.* Hertzian dipole. Also deduce the expressions for electric and magnetic fields.

(b) Derive the expressions for total power radiated from an infinitesimal dipole antenna and its radiation resistance.

4. (1+9)+(2+2)+3+3=20

(a) What are the different types of antenna polarization? Discuss each of them.

(b) What is the axial ratio? What is its value for different types of polarization?

(c) What is the difference between 3*dB* beam width and 3*dB* AR beam width of an Antenna?

(d) What does AR bandwidth mean?

5. (5+1)+4+10=20

(a) For two element array of antennas, derive the expression for total radiated electric field. What is array factor?

(b) Deduce the expression of array factor for *N* element uniform array.

(c) Obtain and sketch the pattern of two isotropic point sources with identical amplitude when the currents are

(i) Fed in phase ($\beta = 0$), $d = \frac{\lambda}{2}$

(ii) Fed 90° out of phase

$\left(\beta = \frac{\pi}{2}\right)$, $d = \frac{\lambda}{2}$.

6. 8+(2+4)+6=20

(a) Describe the basic structure and radiation mechanism of a Microstrip patch antenna with diagram.

(b) Mention the basic parameters used to determine the characteristics of Microstrip patch antenna. Discuss each of them.

(c) Design a rectangular Microstrip patch antenna using a substrate with dielectric constant of 2·4 and height 1·524*mm* and resonating frequency at 6*GHz*.