Total number of printed pages–6

53 (EC 710) AWPR

2019

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 :* 5×20=100

1. 5+5+6+4=20

(a) Describe with necessary diagram, the radiation from a single wire.

(b) How does an oscillating dipole radiate ?

(c) What are the different field regions surrounding a radiating antenna ? Describe each of them.

Contd.

(d) Show graphically, how does the antenna amplitude pattern shape changes from reactive near field towards the far field.

2. 6+4+6+4=20

(a) Describe the different types of radiation patterns.

(b) What does beam area mean for a radiation pattern of an antenna?

(c) Derive the expression of the directivity of an antenna in terms of beam area.

(d) An antenna has a field pattern given by $E(\theta) = \cos^2\theta$ for $0° \le \theta \le 90°$. Find the beam area of this pattern.

3. 2+8+3+7=20

(a) What does input impedance of an antenna 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.

(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

$$\left(\frac{P_r}{P_t}\right) = e_{cdt}\, e_{cdr} \left(1-|\Gamma_t|^2\right)\left(1-|\Gamma_r|^2\left(\frac{\lambda}{4\pi R}\right)^2\right.$$

$$\left. \times D_t(\theta_t, \phi_t)\, D_r(\theta_r, \phi_r) \left|\hat{P}_t \cdot \hat{P}_r\right|^2,\right.$$

where the symbols have their usual meanings.

4. (2+3)+15

(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.

5. (4+4+4)+(4+4)

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

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

6. 20

(a) For two-element antenna array, 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) For the two-element antenna array shown in *Figure*-1, sketch the normalized field pattern when the currents are :

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

(ii) Fed 90° out of phase $\left(\alpha = \frac{\pi}{2}\right)$, $d = \frac{\lambda}{4}$

where α is the phase difference between the elements.

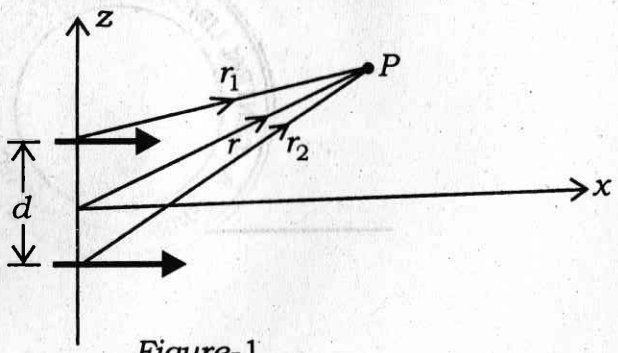

Figure-1

7. 4+4+(3+2)+(2+5)

(a) What are the advantages and disadvantages of microstrip patch antenna ?

(b) How does microstrip patch antenna radiate ?

(c) What is fringe field ? How does it modify the length of the antenna ?

(d) What are the different types of feeding techniques used for microstrip antenna ? Compare these methods in terms of spurious feed radiation, reliability, fabrication, impedance matching and bandwidth.