(Set-1)

B.Tech-8th
Antenna Engineering

Full Marks : 70

Time : 3 hours

Q.No.1 is compulsory and choose any **five** from the rest

The figures in the right-hand margin indicate marks

1. Answer the following questions : 2×10

(*a*) How linear polarization is different from circular polarization ?

(*b*) What is the difference between impedance bandwidth and fractional bandwidth ?

(*c*) Derive the relationship between maximum directivity and maximum effective area.

(*d*) An antenna has a maximum effective aperture of 2·147 m^2 at its operating frequency of 100 MHz. It has no conduction

or dielectric losses. The input impedance of the antenna itself is 75 Ohms, and it is connected to a 50-Ohm transmission line. Find the directivity of the antenna system ("system" meaning includes any effects of connection to the transmission line). Assume no polarization losses.

(*e*) Write down the applications of cassegrain fed antenna.

(*f*) How inset feeding is different from co-axial feeding in a microstrip patch antenna ?

(*g*) Why the dish parabolic antenna is highly directive ? Draw the radiation pattern of the antenna.

(*h*) What is Yagi antenna ? How it is different from log periodic antenna ?

(*i*) Explain the multiplication of radiation patterns.

(*j*) What is half power beamwidth ?

2. What is an antenna array ? Show that

$$|E| = 2\left\{\frac{a_0}{2} + \sum_{k=1}^{k=m}[a_k \cos k\psi + (-b_k)\sin k\psi]\right\}$$

for an *n*-elements array. 10

3. Derive the expressions for the following parameters of a $\lambda/2$ dipole antenna. Draw the radiation patterns showing null and maximum positions. 10

(*i*) Radiated power

(*ii*) Radiation resistance

(*iii*) Effective area

(*iv*) Effective height.

4. Design an end fire array that will produce approximately the pattern described by

$$f(\varphi) = 1 \quad 0 < \varphi < \pi/3$$
$$f(\varphi) = 0 \quad \pi/3 < \varphi < \pi$$

Use an element of one-quarter wavelength. (Choose suitable value of α) 10

5. A lossless, resonant, center-fed $3\lambda/4$ linear dipole, radiating in free space is attached to a balanced, lossless transmission line whose characteristic impedance is 300 ohms. Calculate the 10

(*a*) Radiation resistance (referred to the current maximum)

(*b*) Input impedance (referred to the input terminals)

(*c*) VSWR on the transmission line.

6. A resonant 6-turn loop of closely spaced turns is operating at 50 MHz. The radius of the loop is $\lambda/30$, and the loop is connected to a 50-Ohm transmission line. The radius of the wire is $\lambda/300$, its conductivity is $\sigma = 5{\cdot}7 \times 10^7$ S/m, and the spacing between the turns is $\lambda/100$. (Choose $R_p/R_0 = 0{\cdot}5$) Determine the 10

(*a*) Directivity of the antenna (in dB)

(*b*) Radiation efficiency taking into account the proximity effects of the turns

(*c*) Reflection efficiency

(*d*) Gain of the antenna (in dB).

7. (*a*) What are frequency independent antennas ? Explain the characteristics of a log periodic dipole array with its different regions. 6

(*b*) Explain the procedure for measuring the gain of antenna. 4

8. Design a rectangular microstrip patch with dimensions W and L, over a single substrate, whose center frequency is 10 GHz. The dielectric constant of the substrate is 10·2 and the height of the substrate is 0·127 cm (0·050 inch). Determine the physical dimensions W and L (in cm) of the patch, taking into account field fringing. 10
