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10EC64

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Antennas and Propagation

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. Define the following with respect to antenna :
   i) Directivity
   ii) Radiation pattern
   iii) Effective aperture
   iv) Antenna field zones. **(08 Marks)**

b. Derive the relation between maximum effective aperture and directivity. **(06 Marks)**

c. The effective apertures of transmitting and receiving antennas in a communication system are $8\lambda^2$ and $12\lambda^2$ respectively, with a separation of 1.5km between them. The electromagnetic wave is travelling with a frequency of 6MHz and the total input power is 25KW. Find the power received by the receiving antenna. **(06 Marks)**

2 a. Derive an expression for the total field and plot the field pattern for two isotropic point sources with same amplitude and equal phase spaced $\lambda/2$ apart. **(08 Marks)**

b. A linear array consists of 4 isotropic point sources. The distance between the adjacent elements is $\lambda/2$. The power is applied with equal magnitudes and a phase difference – dr. Obtain the field pattern and find BWFN (Beam width first Null) and HPBW. **(08 Marks)**

c. What are broadside and End fire arrays. **(04 Marks)**

3 a. A magnetic field strength of $5\mu A/m$ is required at a point on $\theta = \pi/2$, 2km away from an antenna in free space. Neglecting ohmic loss, how much power must the antenna transmit if it is,
   i) A hertzian dipole of length $\lambda/25$?
   ii) A half wave dipole?
   iii) A quarter wave monopole? **(08 Marks)**

b. Derive the radiation resistance of short dipole. **(06 Marks)**

c. Explain basic concept of folded dipole antenna and show how impedance transformation is possible using folded dipole. **(06 Marks)**

4 a. Derive an expression for the far field components of a loop antenna. **(08 Marks)**

b. Show that the radiation resistance of a small loop antenna consisting 'N' turns is given by

$$R_{rad} = 31200\left(\frac{NA}{\lambda^2}\right)^2 \Omega.$$ **(08 Marks)**

c. Write short notes on slot antenna. **(04 Marks)**

PART – B

5 a. Explain with a neat figure the working of a Yagi–uda antenna. Mention the general characteristics and salient features of Yagi – uda antenna. **(10 Marks)**

b. A parabolic dish provides a power gain of 50dB at 10 GHz with 70% efficiency. Find out, i) HPBW ii) BWFN iii) Diameter. **(06 Marks)**

c. Write a note on Lens antenna. **(04 Marks)**

6 a. Write a note on :
   i) Ultra wideband antennas
   ii) Turnstile antenna. **(08 Marks)**

   b. Discuss the design considerations of an antenna used for satellite communications. **(08 Marks)**

   c. Discuss briefly about antennas for ground penetrating radar. **(04 Marks)**

7 a. Describe ground wave propagation. **(08 Marks)**

   b. Derive an expression for resultant electric field strength (E_R) at a point due to space wave propagation. **(06 Marks)**

   c. The transmitting and receiving antennas with heights 50metre and 25metre are used to establish a communication link at 150MHz with 100 watts power of transmission. Determine : i) LOS distance ii) strength of received signal. **(06 Marks)**

8 a. Define Maximum Usable Frequency (f_{MUF}). Derive an expression of f_{MUF} for curved surface of earth. **(08 Marks)**

   b. Explain skip distance. Derive an expression for skip distance (D), for flat earth surface. **(06 Marks)**

   c. Assume that reflection takes place at a height of 400 km and that the maximum electron density in the ionosphere corresponds to a 0.9 refractive index at 10 MHz. What will be the range for which MUF is 10 MHz? i) for flat earth ii) for curved earth. **(06 Marks)**

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