

SECTION A

QUESTION 1

Explain the following: [i] Radiation pattern [ii] Fraunhofer region [iii] Fresnel region [iv] Antenna temperature [v] Effective area (20 mks)

QUESTION 2

- (a) Describe the construction and action of a parabolic antenna and sketch a typical radiation pattern of this antenna. Sketch the device incorporating an appropriate feed element used for launching the radio energy. State the band of frequency in which this antenna is most applicable. (10mks)
- (b) Sketch and determine appropriate dimensions of a 4-element folded dipole Yagi antenna suitable for operation at 300MHz. For such an antenna state clearly what is meant by the terms (i) gain and (ii) beam width. (10 mks)

QUESTION 3

- (a) Sketch the following (i) $\frac{\lambda}{4}$ monopole on infinite electric conductor. (ii) $\frac{\lambda}{4}$ monopole using radials as a ground plane, (iii) $\frac{\lambda}{4}$ monopole with center loading coils (iv) a typical side view of the radiation pattern of a $\frac{\lambda}{4}$ monopole. Give 2 areas of application of this antenna (10 mks)
- (b) Why does a transmit antenna radiate electromagnetic field? Consider an antenna placed at the center of a sphere of radius r and radiating at a power P_T . Write an expression showing the power density S due to the isotropic antenna. Hence determine the power density at a transmit power of 10W and distance of 100m (10 mks)

SECTION B

QUESTION 4

- (a) A gain comparison technique is used in determining the gain of an antenna. If the measured difference in the power between the standard antenna and AUT was 5.33 dBm, and Standard antenna's gain was 3. What is the gain of the AUT. (7 marks).
- (b) A new antenna has been purchased by your company explain with the aid of a diagram descriptively how to go about obtaining its radiation pattern and state the various ways they can be displayed. (13 marks)

QUESTION 5

- (a) Explain with the aid of a diagram the setup and explain how the gain of an antenna can be measured. (5marks)
- (b) You are to design a pyramidal horn feed antenna operating at 600MHz with gain 20. Using the optimum functions $G = 0.51 \left(\frac{4\pi}{\lambda^2} AB \right)$ and $A = 0.45\lambda\sqrt{G}$ in your design and a waveguide feed dimension of 20 x 10 cm; What would be (a) horn aperture dimensions A, B, R_2 , R_1 , α_{H1} , α_{E1} , (b) Use scaled sectioned views to present your design pictorially. (15 marks)

QUESTION 6

- (a) Show that an E-plane antenna has its $R_E = (B - b) \sqrt{\left(\frac{l_E}{B} \right)^2 - \frac{1}{4}}$ (8 marks)
- (b) A Base transceiver station (BTS) is to communicate with a Mobile Switching Centre (MSC) at 2.5GHz. If their antenna height are both 5m, and are 10Km apart, calculate the possible hygen's parameters and relative power density when (a) a 15m high building is 1/4 of the distance between BTS and MSC with respect to the BTS (b) a 6m tall tree is 6.7Km from the BTS. (12 marks)