CBCS SCHEME

15EC71

Seventh Semester B.E. Degree Examination, Jan./Feb. 2023
Microwave and Antennas

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Smith Chart is permitted.

Module-1

1 a. Explain the Reflex Klystron operation with mode. **(06 Marks)**

b. Derive the expression for reflection coefficient and transmission coefficient. **(06 Marks)**

c. List the characteristics of Smith Chart. **(04 Marks)**

OR

2 a. A line of $Z_0 = 400\Omega$ is connected to a load of $200 + j300\Omega$ which is exited by matching generator at 800MHz. Find the location and length of a single stub nearest to the load to produce impedance match. Make use of Smith Chart and show all the values. **(08 Marks)**

b. A transmission line has the following parameters:
$R = 2\Omega/m$ $G = 0.5mho/m$ $f = 1GHz$ $L = 8nH/m$ $C = 0.23PF.$
Calculate the: i) Characteristic impedance ii) Propagation constant. **(04 Marks)**

c. With neat block diagram, explain the typical microwave system. **(04 Marks)**

Module-2

3 a. Illustrate the following s-parameter properties i) Symmetry of [s] for a reciprocal network ii) unitary property for lossless junction. **(08 Marks)**

b. List the characteristics of Magic Tees along with s-matrix relation. **(08 Marks)**

OR

4 a. List the significance of following microwave passive device: i) Attenuators ii) Phase shifter. **(04 Marks)**

b. The S-parameter of a two-port network are given by
$S_{11} = 0.2\angle 0^\circ$, $S_{22} = 0.1\angle 0^\circ$, $S_{12} = 0.6\angle 90^\circ$, $S_{21} = 0.6\angle 90^\circ$
Prove that i) The network is reciprocal but not lossless ii) Find the return loss at port 1 when port 2 is short circuited. **(04 Marks)**

c. Explain E-plane tee and H-plane tee along with s-matrix relation. **(08 Marks)**

Module-3

5 a. A lossless parallel strip line has a conducting strip width W. The substrate dielectric separating the two conducting strips has a relative dielectric constant ε_{rd} of 6 and a thickness d of 4mm.
Calculate:
i) The required width W of the conducting strip in order to have a characteristic impedance of 50Ω.
ii) The strip-line capacitance.
iii) The strip-line inductance.
iv) The phase velocity of the wave in the parallel strip line. **(04 Marks)**

b. Define the following related to antenna parameter i) Directivity ii) Radiation intensity. **(05 Marks)**

c. Derive the expression for effective-aperture and directivity of linear dipole $\lambda/2$ antenna. **(07 Marks)**

OR

6 a. Briefly discuss losses in microstrip line. **(03 Marks)**

b. A radio link has a 15-W transmitter connected to an antenna of $2.5m^2$ effective aperture at 5GHz. The receiving antenna has an effective aperture of $0.5m^2$ and is located at a 15-km line of sight distance from the transmitting antenna. Assuming lossless, matched antennas, find the power delivered to the receiver. **(04 Marks)**

c. Calculate the directivity of the source with the pattern $u = U_m \sin\theta \sin^3\phi$ using i) Exact method ii) Approximate method. Choose $0 \le \theta \le \pi$ and $0 \le \phi \le \pi$. **(06 Marks)**

d. Explain Antenna field zones with schematic. **(03 Marks)**

Module-4

7 a. Obtain the expression for the field pattern of two isotropic point source with equal amplitude and equal phase. Assume distance between two source is $\lambda/2$. Also draw the field pattern. **(08 Marks)**

b. Show that radiation resistance of short electric dipole is given by $80\pi^2 L_\lambda^2$. **(08 Marks)**

OR

8 a. Derive an array factor expression in case of linear array of n-isotropic point source of equal amplitude and spacing. **(08 Marks)**

b. Starting from electric and magnetic potential, obtain far field components for short electric depole. **(08 Marks)**

Module-5

9 a. Determine the length L, H-plane aperture and flow angle θ_E and θ_H of a pyramidal horn for which E-plane aperture $a_E = 10\lambda$. The horn is fed by a rectangular waveguide with TE_{10} mode. Let $\delta = 0.2\lambda$ in the E plane and 0.375λ in the H-Plane. Also calculate its beam widths and directivity. **(06 Marks)**

b. Discuss the constructional details of Log-periodic antenna. **(04 Marks)**

c. Derive the field expression for small loop antenna. **(06 Marks)**

OR

10 a. Explain the constructional details of yogi-uda array. **(03 Marks)**

b. Derive the expression for radiation resistance of circular loop of any radius say 'a'. **(06 Marks)**

c. Obtain the expression for instantaneous electric field and magnetic field at a large distance r from a loop of any radius 'a'. **(07 Marks)**

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