CBCS SCHEME

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17EC71

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

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Explain Reflection Klystron amplifier with neat diagram. **(06 Marks)**

b. A Reflex Klystron is to be operated at 10 GHz with dc beam voltage of 300 V, repeller space of 0.1 cm for $1\frac{3}{4}$ mode. Calculate $P_{Rf\,max}$ and corresponding repeller voltage for a beam current of 20 mA. **(06 Marks)**

c. Define Reflection coefficient, transmission coefficient and SWR. Also derive the equation for reflection coefficient at the load end. **(08 Marks)**

OR

2 a. Explain mode curves of reflex klystron and also mention applications in the design of microwave receiver and transmitter circuits. **(06 Marks)**

b. Derive transmission line equations to find voltage and current in terms of Z and L. **(08 Marks)**

c. A transmission line has a characteristic impedance of $100\angle 53.13^\circ$. It is terminated with load impedance. The transmission coefficient is $1.09\angle 35.54^\circ$. Find reflective coefficient and load impedance. **(06 Marks)**

Module-2

3 a. Explain Z, Y and ABCD parameters used for analysis of Radio frequency circuits and its disadvantages. Derive S-matrix of two port network. **(08 Marks)**

b. Write neat diagram of E plane Tee junction and matrix. Analyse 3 dB splitter property. **(05 Marks)**

c. The S parameters of two port network are given by,

$$[S] = \begin{bmatrix} 0.1\angle 0^\circ & 0.8\angle -45^\circ \\ 0.8\angle 45^\circ & 0.2\angle 0^\circ \end{bmatrix}.$$

(i) Determine whether the network is reciprocal and not lossless.
(ii) If Port 2 is terminated with a matched load, calculate return loss at Port 1.
(iii) When Port 2 is short circuited, find return loss at Port 1. **(07 Marks)**

OR

4 a. Write neat diagram for two port network and indicate incident, reflected wave and power. Define insertion loss, transmission loss, return loss in terms of S-parameters. **(06 Marks)**

b. Prove S matrix for MAGIC Tee junction. **(08 Marks)**

c. Write short notes on Coaxial connectors and adapters. **(06 Marks)**

Module-3

5 a. Explain the following terms as related to antenna system:
(i) Directivity (ii) Beam efficiency (iii) Effective aperture (iv) Half power beam width. **(08 Marks)**

b. Discuss different types of losses in microstrip lines. **(07 Marks)**

c. Find the maximum directivity of an antenna whose radiation intensity $U = r^2 W_{rad} = A_0 \sin\theta$. Write an expression for the directivity as a function of the directional angle θ and ϕ. **(05 Marks)**

OR

6 a. Write neat diagram and derive Friss transmission formula and indicate all the antenna parameters clearly. **(06 Marks)**

b. Consider isotropic radiator in polar coordinate showing incremental angle dA on the surface of a sphere of radius r and derive inverse square law of radiation equation. Also write E-plane and H-plane patterns in two-dimensional (2D) plots by considering two orthogonal principal plane cuts of the 3D pattern of a half wave dipole. **(08 Marks)**

c. Explain different types of striplines and highlight the importance of dielectric constant in the design of striplines. **(06 Marks)**

Module-4

7 a. Derive radiation resistance of short electric dipole (R_r). **(06 Marks)**

b. Explain different types of antenna array and explain the principle of pattern multiplication with the help of suitable example. **(08 Marks)**

c. A Hertzian dipole of length $dl = 0.5\,m$ is radiating into free space. If dipole current is 4 A and frequency is 10 MHz. Calculate the highest power density at a distance of 2 km from the antenna. **(06 Marks)**

OR

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

b. Derive directivity of short dipole antenna. **(08 Marks)**

c. Determine total field pattern using principle of pattern multiplication. For 2 sources separated $\frac{\lambda}{2}$ apart and $\delta = 0$ with individual source pattern given by $E = E_o \cos\phi$. **(04 Marks)**

Module-5

9 a. Derive an expression for far fields E_ϕ and H_θ for small loop antenna. **(10 Marks)**

b. Write short note on :

(i) Parabolic antenna.

(ii) Yagi-Uda antenna. **(10 Marks)**

OR

10 a. Show that the radiation resistance of small loop single turn antenna is $31{,}200\left(\frac{A}{\lambda^2}\right)^2$. Calculate the radiation resistance for 50 turns if $\frac{C}{\lambda} = 0.1$. Where C is the circumference of circular loop antenna. **(10 Marks)**

b. Write note on log periodic antenna. **(05 Marks)**

c. Write neat diagram of pyramidal horn antenna and determine the length L, H-plane aperture and flare angle θ_E and θ_H in E and H plane respectively. 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. Calculate H plane aperture. Also calculate beamwidth and directivity. **(05 Marks)**

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