CBCS SCHEME

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21EC62

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Microwave Theory and Antennas

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Derive Transmission line Equations in voltage and current forms. **(08 Marks)**

b. List the characteristics of Smith Chart. **(07 Marks)**

c. A certain transmission line has a characteristic impedance of $75 + j0.01\ \Omega$ and is terminated in a load impedance of $70 + j50\ \Omega$, compute

(i) Reflection co-efficient

(ii) Transmission co-efficient. **(05 Marks)**

OR

2 a. With neat diagram, explain the typical Microwave system. **(07 Marks)**

b. A transmission line has the following parameters, R = 2Ω/m, G = 0.5 mmho/m, f = 1 GHz, L = 8 nH/m, C = 0.23 PF.
Calculate (i) Characteristic impedance (ii) Propagation constant **(05 Marks)**

c. With the help of a functional block diagram, explain construction and modes of working of a GUNN Diode. **(08 Marks)**

Module-2

3 a. Write the S-matrix representation for Mutliport network. **(07 Marks)**

b. With a neat diagram, explain the working of precession type variable attenuator. **(08 Marks)**

c. A 20 mW signal is fed into one of the collinear Port 1 of a lossless H-plane T-junction. Calculate the power delivered through each port when other ports are terminated in Matched load. **(05 Marks)**

OR

4 a. State and explain the properties of S-matrix. **(07 Marks)**

b. What is Magic-tee? Derive its scattering matrix. **(07 Marks)**

c. In an H-plane T-junction, compute power delivered to the loads of 40 ohm and 60 ohm connected to arms-1 and 2 when a 10 mW power is delivered to the matched Port 3. **(06 Marks)**

Module-3

5 a. Discuss briefly Micro-strip lines and its losses and also derive the expression for Quality factor. **(08 Marks)**

b. Define the following terms with respect to antennas:

(i) Radiation Intensity

(ii) Beam area.

(iii) Directivity

(iv) Beam efficiency. **(08 Marks)**

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

OR

6 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 $\in_{rd}$ of 6 and a thickness d of 4 mm. Calculate

(i) The required width W of the conducting strip in order to have a characteristic impedance of 50 Ω.

(ii) The strip line capacitance.

(iii) The strip line inductance.

(iv) The phase velocity of the wave in the parallel strip lines. **(08 Marks)**

b. Show that maximum effective aperture of a λ/2 dipole antenna is $0.13\lambda^2$. **(06 Marks)**

c. Find the Directivity of the following using Exact method,

(i) $U = U_m \sin^2\theta \sin^3\phi$

(ii) $U = U_m \cos^4\theta \sin^2\phi$ where $0 \le \theta \le \frac{\pi}{2}$. $0 \le \phi \le 2\pi$ **(06 Marks)**

Module-4

7 a. Derive the expression and draw the field pattern for two isotropic point sources of the same Amplitude and same phase. **(08 Marks)**

b. Derive the expression for radiation resistance of short electric dipole. **(08 Marks)**

c. Find the length of an Elementary dipole having a radiation resistance of 5Ω at a frequency of 5 MHz. **(04 Marks)**

OR

8 a. Derive array factor expression in case of n isotropic point sources of equal Amplitude and spacing. **(07 Marks)**

b. Starting from Electric and Magnetic field potential, obtain the far field components for a short dipole. **(10 Marks)**

c. For a short dipole $\lambda/15$ long find the radiation resistance. **(03 Marks)**

Module-5

9 a. Obtain the expression for radiation resistance of small loop antenna. **(07 Marks)**

b. Briefly explain helical antenna with its helical geometry. **(05 Marks)**

c. Find the length L, H-plane aperture and flare angle θ_E and θ_H of pyramidal horn for which E-plane aperture is 10λ Horn is fed by a rectangular waveguide with TE_{10} mode. Assume $\delta = 0.2\lambda$ in E-plane and 0.375 λ in H-plane. Also find beam widths and directivity. **(08 Marks)**

OR

10 a. Derive the expression for strength E_ϕ and H_θ in case of small loop Antenna. **(08 Marks)**

b. Explain different types of Horn Antenna. **(06 Marks)**

c. Design Yagi-Uda antenna of six elements to provide a gain of 12 dB, if the operating frequency is 200 MHz. **(06 Marks)**

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