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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, $R = 2 \Omega/m$, $G = 0.5 \text{ mmho/m}$, $f = 1 \text{ GHz}$, $L = 8 \text{ nH/m}$, $C = 0.23 \text{ PF}$. 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 ϵ_{rd} of 6 and a thickness d of 4 mm. Calculate
- The required width W of the conducting strip in order to have a characteristic impedance of 50Ω .
 - The strip line capacitance.
 - The strip line inductance.
 - The phase velocity of the wave in the parallel strip lines. (08 Marks)
- b. Show that maximum effective aperture of a $\lambda/2$ dipole antenna is $0.13 \lambda^2$. (06 Marks)
- c. Find the Directivity of the following using Exact method,
- $U = U_m \sin^2 \theta \sin^3 \phi$
 - $U = U_m \cos^4 \theta \sin^2 \phi$ where $0 \leq \theta \leq \frac{\pi}{2}$ and $0 \leq \phi \leq 2\pi$. (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 0.375λ 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)
