USN | | | | | | | | | | 17EC71

Seventh Semester B.E. Degree Examination, July/August 2022

Microwave 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. Describe the different mode curve in the case of reflex klystron. **(04 Marks)**

b. A transmission line has the following parameters $R = 5\Omega/m$, $L = 5.2 \times 10^{-8}$H/m, $G = 6.2 \times 10^{-3}$ mho/m and $C = 2.13 \times 10^{-10}$F/m. The signal frequency is 4 GHz. Calculate its characteristics impedance and propagation constant. **(06 Marks)**

c. Derive the general transmission line equation to find voltage and current on the line in terms of position 'Z' and time 't'. **(10 Marks)**

OR

2 a. List IEEE recommended micro wave frequency bands. **(04 Marks)**

b. Define reflection coefficient. Derive the equation for reflection coefficient at the load end at a distance 'd' from the load. **(08 Marks)**

c. Discuss the following :
i) Standing Wave Ratio
ii) Single Stub Matching. **(08 Marks)**

Module-2

3 a. Show that impedance and admittance matrices are symmetrical for a reciprocal junction. **(05 Marks)**

b. Draw the diagram of Magic – Tee. Derive S – matrix of the Magic Tee. **(10 Marks)**

c. A shunt impedance Z is connected across a transmission line with characteristics impedance Z_0. Find the S – matrix of the junction. **(05 Marks)**

OR

4 a. With a neat diagram explain the working of precision phase shifter. **(08 Marks)**

b. A 20mW 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. **(04 Marks)**

c. With diagrams explain E – plane Tee and H – Plane Tee. **(08 Marks)**

Module-3

5 a. Derive the characteristic impedance of microstrip lines. **(08 Marks)**

b. Explain basic radiation equation in brief. **(05 Marks)**

c. What is maximum power received at a distance of 0.5km over a free – space 1 – GHz circuit consisting of a transmitting antenna with a 25 – dB gain and a receiving antenna with a 2-dB gain? The gain is with respect to a lossless isotropic source. The transmitting antenna input is 150W. **(07 Marks)**

OR

6 a. Explain ohmic losses and radiation losses in detail. **(08 Marks)**

b. Show that maximum effective aperture of a $\lambda/2$ dipole antenna is $0.13\lambda^2$. **(07 Marks)**

c. 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. **(05 Marks)**

Module-4

7 a. Derive an expression and draw the field pattern for an array of 2 isotropic point sources with same amplitude and phase spaced $\lambda/2$ apart. **(08 Marks)**

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

c. A source has a radiation intensity pattern given by $U = U_m \cos\theta$ for $\theta \le \theta \le \pi/2$ and $0 \le \phi \le 2\pi$. Find the total power and directivity. **(04 Marks)**

OR

8 a. Derive an array factor expression in case of linear array of 'n' isotropic point source of equal amplitude and spacing. **(10 Marks)**

b. State and explain power theorem. **(05 Marks)**

c. Find the power radiated by a 10-cm dipole antenna operated at 50MHz with an average current of 5mA. How much (average) current would be needed to radiate power of 1W. **(05 Marks)**

Module-5

9 a. With neat diagram, explain the operation of log-periodic antenna. Write design equations. **(05 Marks)**

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

c. Determine the length L, H – plane aperture and flare angle θ_E and θ_H of a pyramidal horn for which the 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 find beam widths and directivity. **(08 Marks)**

OR

10 a. A 16-turn helical beam antenna has a circumference of λ and turn spacing of $\lambda/4$.
Find : i) HPBW ii) Axial Ratio iii) Directivity. **(05 Marks)**

b. Discuss :

i) Helical Antenna

ii) Modern –version 6 – element Yagi – Uda antenna. **(08 Marks)**

c. Derive the expression for strength E_ϕ and H_ϕ in case of small loop. **(07 Marks)**

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