CBCS SCHEME

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 $\theta \leq \theta \leq \pi/2$ and $0 \leq \phi \leq 2\pi$. 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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