CBCS SCHEME

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15EC71

Seventh Semester B.E. Degree Examination, June/July 2023
Microwaves and Antennas

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Discuss mechanism of oscillation in Reflex Klystron with schematic. **(06 Marks)**

b. A Reflex Klystron is to be operated at 10GHz with dc beam voltage 300V, repeller space 0.1cm for $1\frac{3}{4}$ mode. Calculate P_{RFmax} and corresponding repeller voltage for a beam current of 20mA. **(05 Marks)**

c. A transmission line has the following parameters:
R = 2Ω/m, G = 0.5mho/m, f = 1GHz, L = 8nH/m and C = 0.23 PF.
Calculate its characteristics impedance and propagation constant. **(05 Marks)**

OR

2 a. A line of 400Ω is connected to a load of 200 + j300Ω which is excited by a matched generator at 800MHz. Find the location and length of a single stub nearest to the load to produce an impedance match. **(08 Marks)**

b. A certain transmission line has a characteristic impedance of 75 + j0.01Ω and is terminated in a load impedance of 75 + j50Ω. Compute: i) Reflection coefficient ii) The transmission coefficient. **(04 Marks)**

c. What are the high frequency limitations of conventional vacuum tube / transistors? **(04 Marks)**

Module-2

3 a. Write short notes on :
i) Attenuator
ii) Phase shifters. **(08 Marks)**

b. Explain the properties of S-parameters for junction of ports having common characteristic impedance. **(08 Marks)**

OR

4 a. A 20 MW signal is fed into one of the collinear part 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)**

b. Write the characteristics of Magic Tee. Also obtain scattering matrix for Magic Tee. **(08 Marks)**

c. Write short notes on : Coaxial connectors and adapters. **(04 Marks)**

Module-3

5 a. A microstrip line is composed of zero thickness copper conductors on a substrate having $\epsilon_r = 8.4$ tan $\delta = 0.0005$ and thickness 2.4mm. If the line width is 1mm and operated at 10 GHz, calculate :
i) The characteristic impedance
ii) The attenuation due to conductor loss and dielectric loss. **(08 Marks)**

b. Define the following :
i) Beam area
ii) Radiation resistance
iii) Beam efficiency
iv) Radiation intensity. **(08 Marks)**

OR

6 a. Obtain effective aperture and directivity of a half wave dipole. **(05 Marks)**

b. Derive Friis transmission formula. **(05 Marks)**

c. Obtain relationship between directivity and effective aperture. **(06 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. **(06 Marks)**

b. Show that the radiation resistance of $\lambda/2$ antenna is 73Ω. **(06 Marks)**

c. A source has a radiation intensity power pattern given by $U = U_m \sin^2\theta$ for $1 \leq \theta \leq \pi/2$; $0 \leq \theta \leq 2\pi$. Find the total power and directivity. **(04 Marks)**

OR

8 a. Derive the expressions for the far field components of short dipole. **(08 Marks)**

b. Explain the principle of pattern multiplication with an example. **(08 Marks)**

Module-5

9 a. Obtain the expression for radiation resistance of small loop antenna. **(08 Marks)**

b. With neat diagram explain the operation of log-periodic antenna. **(08 Marks)**

OR

10 a. Determine the length L_1 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 what are beam widths and what is the directivity. **(08 Marks)**

b. Discuss the following antenna types :
i) Helical Antenna
ii) Yagi-uda-array. **(08 Marks)**

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