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10EC54

Fifth Semester B.E. Degree Examination, June/July 2019
Microwave and Radar

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting atleast TWO questions from each part.*
2. Use of Smith chart to be provided.

PART – A

1 a. Starting from the fundamentals, derive expressions for voltage and current at any point on a microwave transmission line, by the method of distributed circuit theory. **(10 Marks)**

b. A telephone line has the primary constants, R = 6 Ω/km, L = 2.2 mH/km, c = 0.005 μF/km and G = 0.05 μ℧/km. Determine Z_0, α, β, V_p and λ at 1 kHz. **(10 Marks)**

2 a. Define : (i) Reflection coefficient (ii) Standing wave Ratio (iii) Transmission coefficient and (iv) Derive the relationship between reflection coefficient and standing wave ratio and the relation between Reflection coefficient and Transmission coefficient. **(10 Marks)**

b. A line of characteristic resistance R_0 = 400 Ω is terminated in a load impedance $Z_L = (200 + j300)\Omega$ and is excited by a matched generator at 800 MHz. Using Smith chart determine the location and length of a single stub nearest the load, to produce an impedance match. **(10 Marks)**

3 a. Explain various modes of operation of a Gunn Diode. Explain Ridley Watkin Hilsum theory. **(10 Marks)**

b. With a neat diagram, explain the working of a Two-Hole directional coupler. Derive the scattering matrix of the same. **(10 Marks)**

4 a. List various properties of S-matrix and starting from the impedance matrix equation prove the symmetry property of a reciprocal network. **(10 Marks)**

b. Obtain the relationship between the scattering parameters and ABCD parameters. **(10 Marks)**

PART – B

5 a. With a neat sketch, explain the characteristics and working of a Magic Tee. Derive its matrix. **(10 Marks)**

b. A 20 mW signal is fed into one of collinear port 1 of a lossless H-plane Tee function. Calculate the power delivered through each port when other ports are terminated in matched loads. **(05 Marks)**

c. "Hybrid Ring (Rat-Race circuit) performs similar functions as that of a magic tee, constructionally different". Substantiate the working of a Rat-Race circuit with a neat sketch and arrive at the scattering matrix. **(05 Marks)**

6 a. With a neat sketch, explain the construction of a microstrip line. Derive expression for attenuation constants and dielectric losses of a Parallel strip line. **(12 Marks)**

b. A lossless parallel strip line has a conducting strip 'W'. The substrate dielectric separating the two conducting strips has a relative dielectric constant $\in_{rd}$ of 6(beryllia or beryllium oxide BeO) and a thickness 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 line. **(08 Marks)**

7 a. With a neat block diagram, explain the operation of a basic Radar system. **(10 Marks)**
b. Derive the basic Radar Range equation as governed by the minimum receivable echo power P_{min}. **(10 Marks)**

8 a. With a neat block diagram, explain the working of the Moving Target Indicator (MTI) Radar. **(12 Marks)**
b. Write explanatory notes on 'Doppler Effect', employed in Doppler Radar systems. **(04 Marks)**
c. For an MTI Radar determine the first three Blind speeds at 2 GHz, when the Pulse Repetition Frequency (PRF) is 1 kHz. **(04 Marks)**

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