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10EC54

Fifth Semester B.E. Degree Examination, Aug./Sept.2020

Microwaves and Radar

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of Smith chart is allowed.***

PART – A

1 a. Define the following terms as referred to a transmission line:
(i) Standing waves
(ii) Reflection coefficient
(iii) VSWR
(iv) Transmission coefficient
(v) A matched transmission line **(10 Marks)**

b. A load impedance of $(60 - j80)\Omega$ is to be matched to a 50Ω coaxial line by using a single short circuited stub. The wave length of operation in 1 meter. Using Smith chart, find:
(i) The VSWR
(ii) Location 'd' of the stub with respect to load and length 'ℓ' of the stub
(iii) The position of first V_{max} and first V_{min} of the standing wave with respect load end. **(10 Marks)**

2 a. With constructional diagram, explain the working of a Faraday rotation isolator. **(08 Marks)**

b. A matched isolator has insertion loss of 0.5 dB and isolation loss of 25 dB. Find the scattering matrix of the isolator. **(04 Marks)**

c. With a diagram, explain a four port circulator that uses two directional couplers. Explain with diagram how a four port microwave circulator can be realized using two magic Tees. **(08 Marks)**

3 a. With relevant plots, waveforms and constructional diagrams, explain Gunn effect in a n-type GaAs slice. What are the differences between micro wave transistors and microwave TEDs? **(10 Marks)**

b. Write a note on PIN diode. With diagrams, show any three applications of PIN diode, explain these in briefly. **(10 Marks)**

4 a. Prove that the impedance and admittance matrices are symmetrical for a reciprocal network junction. **(06 Marks)**

b. Write the S-matrix for an n-port network. **(06 Marks)**

c. Starting from the impedance matrix equation, prove the symmetry property of S-matrix of reciprocal networks. **(08 Marks)**

PART – B

5 a. With neat diagram, explain the construction and working of a precision type variable waveguide attenuator, with matched ports. Derive its S-matrix. **(09 Marks)**

b. Starting from the characteristics of H-plane waveguide Tee junction derive its S-matrix. **(07 Marks)**

c. With diagram, explain how a magic-Tee can be used as a duplexer in RADAR system. **(04 Marks)**

6 a. Explain the constructional features microstrip lines. Discuss the characteristic impedance and effective relative dielectric constant of a microstrip line. **(09 Marks)**

b. Briefly explain the various losses in microstrip lines. **(06 Marks)**

c. A lossless parallel strip line has a conducting strip width W. The dielectric substrate separating the two conducting strips has a relative dielectric substrate of 6 and thickness of the dielectric substrate is 4 mm. 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

(iv) The phase velocity of the wave in the parallel strip line **(05 Marks)**

7 a. Derive the simple form of RADAR range equation. **(07 Marks)**

b. What are the applications of RADARs? **(06 Marks)**

c. A RADAR transmitter operates at 10 GHz and transmits 250 KW of peak pulse power. If the antenna used by the transmitter and receiver has a gain of 4000 and the power received from a target at 50 km is 10^{-11} W, what is the RADAR cross section of the target? **(07 Marks)**

8 a. Explain the principle and working of MTI radar with a block diagram. What are its advantages? **(10 Marks)**

b. With a neat block diagram of a delay line canceller explain the working principle. In the case of single delay line canceller derive the expression for the amplitude of the output. Hence draw the amplitude versus frequency plot. **(10 Marks)**

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