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10TE64

Sixth Semester B.E. Degree Examination, June/July 2017

Microwaves and Radar

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Derive the line impedance of a lossless transmission line in terms of hyperbolic functions. **(10 Marks)**

b. A 300Ω lossless line is terminated in a load of (600 + j300)Ω operating at 600 MHz, find SWR on the line. Design a single stub matching section, assuming main line and stub are of same type. **(10 Marks)**

2 a. What are cavity resonators? List the applications. **(05 Marks)**

b. Derive TM_{mn} field equations in rectangular waveguide. **(08 Marks)**

c. Briefly explain the following microwave devices:
i) Hybrid rings
ii) Waveguide corners, bends and twists. **(07 Marks)**

3 a. Discuss the criteria for classifying the modes of operation for Gunn effect diodes and explain with a neat sketch the working of Gunn diode in LSA mode. **(07 Marks)**

b. With a neat sketch, explain how PIN diode acts as a single pole switch. Find the expression for insertion loss. **(07 Marks)**

c. An upconverter parametric amplifier has the following parameters:
Ratio of o/p frequency to signal frequency is 25.
Figure of merit = 10
Factor of merit figure = 0.4
Diode temperature = 350 K
T_0 = 300 K
Find the power gain in dB, noise figure in dB and bandwidth. **(06 Marks)**

4 a. Derive an expression of the input reflection coefficient of a 2 port network with mismatched load. **(06 Marks)**

b. Define different losses in terms of s-parameters. **(06 Marks)**

c. Explain the relation between incident and reflected waves in terms of scattering parameters for a multiport network. Also explain physical significance of s-parameters. **(08 Marks)**

PART – B

5 a. With neat diagrams, explain different types of attenuators. **(07 Marks)**

b. Explain the applications of magic tee as an impedance bridge and power combiner. **(08 Marks)**

c. Why are coaxial connectors and adaptors used? List different types of coaxial connectors with their frequency ranges. **(05 Marks)**

6 a. Write the equations for ϵ_{eff} and z_0 for $\frac{w}{h} >> 1$ and $\frac{w}{h} << 1$ for a microstrip line. **(06 Marks)**

b. Explain the different losses in microstrip line. **(08 Marks)**

c. A gold parallel strip line has following parameters:
$\in_{rd} = 2.5$
Strip width = 26 mm
Separation distance, d = 5 mm
Conductivity of gold, $\sigma_c = 4.1 \times 10^7$ ℧/m
Frequency, f = 10 GHz
Determine: i) Surface resistance of the gold string
ii) Characteristic impedance Z_o
iii) Phase velocity **(06 Marks)**

7 a. Explain the terms maximum unambiguous range and range to a target. Also obtain the simple form of radar range equation. **(08 Marks)**

b. With a neat block diagram, explain the basic principle of radar. **(06 Marks)**

c. A ground based air surveillance radar operates at a frequency of 1300 MHz. Its maximum range is 200 nmi for detection of target with a radar cross section of one square meter (σ = 1 m^2). Its antenna is 12m wide by 4m high and the antenna aperture efficiency is ρ_a = 0.65. The receiver minimum detectable signal is $S_{min} = 10^{-13}$ W. Determine the following:
i) Antenna effective aperture A_e and antenna gain.
ii) Peak transmitter power.
iii) Pulse repetition frequency to achieve a maximum unambiguous range of 200 nmi.
iv) Average transmitter power, if pulse width is 2μs.
v) Duty cycle
vi) Horizontal beamwidth **(06 Marks)**

8 a. With a neat block diagram, explain original moving target detector signal processor. **(08 Marks)**

b. With a neat block diagram, explain pulse Doppler radar and derive maximum radial velocity. **(06 Marks)**

c. Explain with a block diagram, pulse radar that extracts Doppler frequency shifted echo signal from moving target. **(06 Marks)**

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