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06EC54

Fifth Semester B.E. Degree Examination, December 2012
Microwaves and Radar

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. Candidates are allowed to use Smith charts.

PART – A

1 a. Define SWR and reflection co-efficient of a microwave transmission line. **(06 Marks)**

b. The normalized impedance of a microwave transmission line $Z_l = 1 + jl$ and the operating wavelength λ = 5 cm. Using Smith chart determine the first voltage maxima, first voltage minima from the load. Also find VSWR. **(09 Marks)**

c. Describe the single stab matcher. **(05 Marks)**

2 a. Derive TM_{mn} mode characteristic equations in rectangular waveguides. **(10 Marks)**

b. The TE_{10} mode is described as the dominant mode in rectangular waveguides. What property does it have which makes it dominant? **(05 Marks)**

c. What are cavity resonators? What applications do they have? **(05 Marks)**

3 a. Draw the schematic diagram of an IMPATT diode, and explain its operation. **(10 Marks)**

b. A typical n-type GaAs Gunndiode has following parameters:
Threshold field E_{th} = 2800 V/cm
Applied voltage E = 3200 V/cm
Device length L = 10 μm
Doping concentration $n_0 = 2 \times 10^{14}\ cm^{-3}$
Operating frequency f = 10 GHz
i) Compute the electron drift velocity.
ii) Calculate the current density.
iii) Estimate the negative electron mobility. **(06 Marks)**

c. Briefly explain the operation of PIN diode. **(04 Marks)**

4 a. What are the advantages of [S] matrices over [Z] matrices? **(06 Marks)**

b. List the common properties for [S] and [Z] matrices. **(04 Marks)**

c. Define insertion loss, transmission loss, return loss interms of s-parameters. **(10 Marks)**

PART – B

5 a. With the aid of neat sketch, describe characteristics and s-matrix for Magic – Tee **(10 Marks)**

b. Justify the statement : "An ideal isolator is a non reciprocal transmission device" **(05 Marks)**

c. Briefly explain the operation of phase shifter. **(05 Marks)**

6 a. Obtain the attenuation constants for the conductor and dielectric losses of a parallel strip line. **(06 Marks)**

b. A lossless parallel strip line has a conducting strip width 'W'. The substrate dielectric separately the two conducting strips has a relative dielectric constant E_{rd} of 6 (Beryllium oxide BeO) and thickness of 'd' 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)**

c. What are the advantages of coplanar strip line over conventional parallel strip line? **(06 Marks)**

7 a. Draw the block diagram of a basic radar set and explain the essential of its operation. **(06 Marks)**

b. Derive the basic radar range equation, as governed by the minimum receivable echo power P_{min}. **(10 Marks)**

c. Calculate the maximum range of a radar system which operates at 3 cm. With peak pulse power of 500 kW, if its minimum receivable power is 10^{-13}W , the capture area of its antenna is 5 mt^2 and the radar cross-sectional area of the target is 20 mt^2. **(04 Marks)**

8 a. With the aid of a block diagram, explain fully the operation of an MTI radar system using a power amplifier in the transmitter. **(12 Marks)**

b. What is the Doppler effect? **(04 Marks)**

c. What are the advantages offered by digital MTI processing? **(04 Marks)**

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