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10EC54

Fifth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Microwaves & 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 transmission line equations by the method of distributed circuit theory. **(10 Marks)**

b. A 300 Ω line is terminated in a load of (600+j300) Ω operating at 600 MHz. Find the value of SWR and design a single stub matching system. **(10 Marks)**

2 a. Using Helmholtz equation, derive the field equations for TM mode in rectangular waveguide. **(10 Marks)**

b. What is circulator? Explain the working of a 4-port circulator using magic tees and write its S-matrix. **(10 Marks)**

3 a. What is GUNN diode? Explain LSA and TT modes. **(10 Marks)**

b. What are the difference between microwave transistor and TEDs? Give few examples. **(05 Marks)**

c. An IMPATT diode with nominal frequency 10 GHz has C_j = 0.5 pF, L_p = 0.5 nH and C_P = 0.3 pF at breakdown bias of 80 V and bias current 80 mA. The RF peak current is 0.65 A for $R_d = -2\,\Omega$. Find i) Resonant frequency ii) Efficiency. **(05 Marks)**

4 a. State and prove symmetric property of S-matrix. **(08 Marks)**

b. What are S-parameters? Explain the S-parameters for two port network. **(08 Marks)**

c. The S-parameters of a 2 port network are given by $S_{11} = 0.2\angle 0$, $S_{22} = 0.1\angle 0$, $S_{12} = 0.6\angle 90^\circ$ and $S_{21} = 0.6\angle 90^\circ$. Is the network reciprocal? Lossless? **(04 Marks)**

PART – B

5 a. What is attenuator? Derive its S-matrix. **(08 Marks)**

b. Write a note on: i) Phase shifter ii) Coupling loop. **(06 Marks)**

c. A 20 mW signal is fed into one of the collinear port 1 of a lossless H-plane T junction. Calculate the power delivered through each port when other ports are terminated in matched load. **(06 Marks)**

6 a. Write a note on lossless in the microstrip line. **(08 Marks)**

b. Explain co-planar strip lines and shielded strip line. **(06 Marks)**

c. A shielded strip line has the following parameters $\varepsilon_r = 2.56$, strip width = 25 mils, strip thickness = 14 mils and shield depth = 70 mils. Calculate: i) the k-factor ii) fringe capacitance iii) Impedance of the line. **(06 Marks)**

7 a. Derive the basic radar range equation. **(10 Marks)**

b. Write a note on: i) Origin of radar ii) Applications of radar. **(04 Marks)**

c. A 10 GHz radar has the following characteristics $P_t = 250\,kW$, Prf = 1500 PPS, pulse width = 0.8 μs, power gain of antenna = 2500, $S_{min} = 10^{-14}$ W, A_e = 10 m^2, $\sigma = 2\ m^2$. Find i) R unambiguous ii) Maximum possible range iii) Duty cycle iv) Average power. **(06 Marks)**

8 a. What is blind speed? How can we eradicate it? **(08 Marks)**

b. Explain digital MTI processing. **(08 Marks)**

c. A CW radar operates at a frequency of 10 GHz. What is the Doppler frequency produced by i) an aeroplane plying at a speed of 250 kmph ii) a man crawling at 2.5 cm/sec. What do you understand? **(04 Marks)**

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