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BANGALORE - 560 037

Fifth Semester B.E. Degree Examination, June/July 2018
Microwave 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. What are distributed parameters of a Transmission line? Derive characteristic impedance (Z_0) and propagation constant for a microwave transmission line. (06 Marks)
b. Derive the expression for input impedance of a transmission line terminated with a load impedance of Z_L . (06 Marks)
c. A line of $R_0 = 400 \Omega$ is connected to a load impedance of $200 + j300 \Omega$, which is excited by a matched generator at 800 MHz. Find the location and length of a single stub nearest to the load to produce an impedance match. (08 Marks)
2. a. Derive electric and magnetic field components for TE modes in rectangular waveguide. (08 Marks)
b. With neat sketches, explain directional coupler and derive its s-matrix. (08 Marks)
c. Explain rectangular microwave cavity resonators with necessary diagrams and expressions. (04 Marks)
3. a. Explain RWH theory with reference to the Gunn diode operation. (08 Marks)
b. Describe the operating principle of IMPATT diode and obtain the expressions for output power and efficiency. (08 Marks)
c. An M-Si-M BARITT diode has the following parameters :
Relative dielectric constant of $S_i : \epsilon_r = 11.8$
Donor concentration : $N = 3 \times 10^{21} \text{ m}^{-3}$
 S_i length : $L = 6.2 \mu\text{m}$
Calculate : (i) breakdown voltage
(ii) breakdown electric field (04 Marks)
4. a. Describe the properties of s-matrix. (08 Marks)
b. Prove that impedances and admittances are symmetrical for a Reciprocal network. (06 Marks)
c. The S-parameters of a two-port network are given by, $S_{11} = 0.2 \angle 0^\circ$, $S_{22} = 0.1 \angle 0^\circ$, $S_{12} = 0.6 \angle 90^\circ$, $S_{21} = 0.6 \angle 90^\circ$ (i) Prove that the network is reciprocal but not lossless
(ii) Find the return loss at Port 1 when Port 2 is short circuited. (06 Marks)

PART – B

5. a. Obtain the S-matrix for a Magic-T and explain its applications. (10 Marks)
b. With neat sketches, explain the operation of precision type variable attenuator. (06 Marks)
c. A 20 mW signal is fed into one of the collinear ports 1 of a lossless H-plane Tee. Calculate the power delivered through each port when other parts are terminated in matched load. (04 Marks)

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- 6 a. Explain various lossless in strip lines. (08 Marks)
b. Describe parallel strip lines and express distributed parameters in terms of strip line dimensions. (08 Marks)
c. A shielded strip line has the following parameters: Dielectric constant of insulator, $\epsilon_r = 2.56$, strip width $W = 25$ mils, Strip thickness $t = 14$ mils, shield depth $d = 70$ mils. Calculate (i) The K factor (ii) The fringe capacitance (iii) The characteristic impedance. (04 Marks)
- 7 a. Derive simple form of Radar range equation. (08 Marks)
b. Describe the various applications of Radar. (06 Marks)
c. A Radar operating at 3 GHz is radiating power of 200 kW. Calculate the power of the reflected signal at the Radar with a 20 m^2 target at 5.56 km. Given $A_e = 9 \text{ m}^2$. (06 Marks)
- 8 a. With a neat block diagram explain M.T.I Radar. (07 Marks)
b. What are delay line cancellers? Explain. (07 Marks)
c. A 3.25 cm pulse Doppler RADAR has a pulse repetition frequency of 4000PPS. Find (i) Maximum unambiguous range. (ii) Maximum Doppler frequency shift and (iii) Maximum radial velocity of the target. (06 Marks)

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