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BT-7/DX

MICROWAVE ENGINEERING

Paper : ECE-407(E)

Option–II

Time : Three Hours] [Maximum Marks : 100

Note : Attempt any *five* questions by selecting at least *one* question from each section.

SECTION–I

1. (a) What do you mean by a grounded Co-planar waveguide, describe using its schematic diagram, and also explain open and short grounded Co-planar waveguides by giving expressions of open capacitance and short end inductance respectively? 4+4+4=12

(b) For a cylinderical resonator cavity having radius 3 cm, length 6 cm, operating in TE_{111} mode, the value of P'_{nm} is 1.841. If skin depth is 1.53×10^{-7} cm and λ_o is 10 cm then calculate Q (quality factor) of resonator. 8

2. (a) Explain any three methods of measuring microwave power using suitable diagrams. 4+4+4=12

(b) To measure power, measurement setup have power meter, a 22 dB coupler is used and attenuation of attenuator is 8 dB. The power sensor is having VSWR at the input end as 1.52. When power meter reads 18 dBm. Calculate power through main arm and auxillary arm. 4+4=8

SECTION–II

3. (a) Explain importance of slow Wave structures in Travelling Wave Tube amplifier and compare characteristics of Klystron and Travelling Wave Tube (TWT) amplifiers. 6+4=10

   (b) In a two cavity klystron the gap in input cavity is 2mm. The two cavities are separated by a distance 5 cm. The beam voltage is 1000 volt and operating frequency is 8.5 GHz. Calculate V_i (voltage across cavity gap) to keep bunching parameter equals to 0.8. 10

4. (a) Why conventional Vacuum tubes are less useful at frequencies above 1 GHz ? Give reasons to support your answer and name those tubes which can be used above 1 GHz. 8+2=10

   (b) A TWT is having a pitch angle 5.2°. The operational frequency is 7 GHz, if beam voltage is 1800 volt, then calculate frequency of velocity fluctuation. 3

   (c) Derive expressions for axial electric field for travelling Wave Tube. 7

SECTION–III

5. (a) Prove that for a lossless junction the product of any column of scattering matrix with the complex conjugate of any other column is zero? 10

   (b) On measurement of a two port network the following scattering matrix is obtained:

$$[s] = \begin{bmatrix} 0.1\angle 0° & 0.8\angle 9° \\ 0.8\angle 90° & 0.2\angle 0° \end{bmatrix}$$

Determine whether the network is reciprocal or lossless. If a short circuit is placed on port 2, what will be resulting return loss at port 1? 10

6. (a) What do you mean by Attenuator? Explain its basic types using necessary diagrams and explain precision type attenuator in detail? 2+3+5=10

   (b) Design a centre Bethe-hole Directional coupler with air filled rectangular waveguide of dimensions 0.9 × 0.4 $inch^2$ at 9.8 GHz for 20 dB coupling and 40 dB directvity. 10

SECTION–IV

7. (a) Explain GUNN effect and how high field domain formation occurs and what are the properties of this domain? 4+4+4=12

   (b) A M-Si-M BARITT diode have donor concentration N = 2.8×10^{21} m^{-3}, Si length L = 6μm and E_r is 11.8. Calculate breakdown voltage and breakdown Electric field. 4+4=8

8. (a) Explain physical structure, principle of operation and plasma formation of TRAPATT diode, with help of diagram and also explain its V-I characteristics. 3+3+3+3=12

   (b) Explain the operation of parametric amplifiers by giving its physical description, reactance and power relations. 8