7-12-2019

Roll No. ..... Total Pages : 04

BT-7/D-19 37011

MICROWAVE ENGINEERING

ECE-407-E

Time : Three Hours] [Maximum Marks : 100

Note : Attempt *Five* questions in all, selecting *one* question from each Unit.

Unit I

1. (a) A rectangular air filled copper waveguide with dimension 0.9 inch × 0.4 inch cross section and 12 inch length is operated at 9.2 GHz with a dominant mode. Find (a) cut-off frequency (b) guide wavelength (c) phase velocity (d) characteristic impedance ? 8

   (b) Derive the expressions to calculate the unloaded Q factor for a coaxial cavity resonator. 12

2. Explain the following :

   (i) Double Minimum method of VSWR Measurements.

   (ii) Power Ratio method of Attenuation Measurements.

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Unit II

3. (a) A Reflex Klystron operates under the following conditions :

V_0 = 600 V, L = 1 mm, R_{sh} = 15 kΩ and frequency of operation (f_r) is 9 GHz. The tube is oscillating at f_r at the peak of $n = 2$ and $1\frac{3}{4}$ mode. Transit time through cavity gap and beam loading effects are small. Find the value of Repeller voltage, direct current required to give a microwave gap voltage of 200 V, output power and electronic efficiency. **10**

(b) Derive the expressions for beam current density in Multi-cavity Klystron Amplifier. **10**

4. (a) A TWT operates at 10 GHz with beam voltage (V_0) of 3000 Volts, beam current (I_0) is 30 mA, characterisitic impedance (Z_0) of 10Ω and circuit length (N) equals to 50. Determine (i) gain parameter (ii) output power gain (iii) all four propagation constants. **10**

(b) What is the phenomenon of π-mode oscillations in cylindrical magnetron ? **10**

Unit III

5. (a) Prove that the three ports of a lossless passive Tee junction, when reciprocal in nature cannot be matched simultaneously. **10**

   (b) Explain the working of Magic Tee and derive its S-matrix with numerical values. **10**

6. (a) What do you mean by an Attenuator ? Explain the working of a precision variable attenuator and derive its s-Matrix. **10**

   (b) Explain the operation of a 4-port directional coupler. How can it be utilized to measure the VSWR of a given load ? **10**

Unit IV

7. (a) Explain the Two Valley Model Theory in context of GUNN oscillation phenomenon. **10**

   (b) An IMPATT diode operates with carrier drift velocity (vs) of 1.5×107 cm/s, length of drift region (L) is 8μm, maximum operating current (I_{max}) equals to 180 mA, maximum operating voltage (V_{max}) = 90 volts and efficiency is 10%. Calculate (a) the maximum CW output power in watts and (b) the frequency of output power in GHz ? **10**

8. (a) A M-Si-M BARITT diode has relative dielectric constant for Si is 11.8, donor concentration N = 2.8×10^{21} m^{-3} and silicon length L is 6 μm. Calculate (i) breakdown voltage (ii) breakdown electric field ? **10**

(b) Explain the physical structure and principle of operation of the TRAPATT diode. **10**

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