53 (EC 601) MWEN

2014

MICROWAVE ENGINEERING

Paper : EC 601

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. *(a)* Find the expression for reflection coefficient and transmission coefficient in terms of load impedance and characteristic impedance. Also find the relation between them. 14

   (b) A certain transmission line has a characteristic impedance of $50 + 0{\cdot}5j\Omega$ and is terminated with a load impedance of $40 + j\Omega$. Find

   (i) Reflection coefficient

   (ii) Transmission coefficient

   (iii) SWR. 6

2. *(a)* An airfilled rectangular waveguide with a cross section of $2 \times 1 cm^2$ transports energy in the TE_{10} mode at the rate of $0 \cdot 5 hp$. The impressed frequency is $30 GHz$. What is the peak value of electric field occurring in the guide ? 12

(b) An airfilled circular waveguide of radius $2 cm$ is to carry energy at a frequency of $10 GHz$ in TE_{11} $(1 \cdot 841)$ mode. Find

(i) Cutoff frequency

(ii) Phase constant

(iii) Wavelength

(iv) Wave impedance. 8

3. State the properties of an S-matrix. Using these properties find the reduced S-matrix for

(i) E-plane tee

(ii) H-plane tee

(iii) Magic tee. 20

4. *(a)* For a two Cavity Klystron find the expression for exit velocity from the buncher gap. 10

(b) What is the difference between a two cavity Klystron and a reflex Klystron. 4

(c) A reflex Klystron operates under the following conditions :

$V_0 = 600V$ $L = 1mm$

$R_{sh} = 15K\Omega$ $\frac{e}{m} = 1{\cdot}759 \times 10^{11}$ (MKS system)

$fr = 9GHz$

The tube is oscillating at fr at the peak of the $n = 2$ mode or $1\frac{3}{4}$ mode. Assume that the transit time through the gap and beam loading can be neglected.

(i) Find the value of repeller voltage

(ii) Find the direct current necessary to give a microwave gap voltage of $200V$.

(iii) What is the electronic efficiency under this condition ? 6

5. *(a)* A travelling wave tube (TWT) operates under the following parameters :

Beam voltage : $V_0 = 3KV$

Beam current : $I_0 = 30mA$

Characteristic impedance of helix : $Z_0 = 10\Omega$

Circuit length : N = 50

Frequency : $f = 10\ GHz$

Determine —

(i) the gain parameter C

(ii) the output power gain A_P in decibels

(iii) All *four* propagation constants 12

(b) Find the Hull cut of magnetic equation for a Cylindrical Magnetron. 8

6. *(a)* Explain the two valley model theory. 10

(b) A typical n-type GaAs Gum diode has the following parameters :

Threshold field : $E_{th} = 2800\ V/cm$

Applied field : $E = 3000\ V/cm$

Device length : $L = 12rm$

Doping concentration : $n_0 = 2 \times 10^{15}\ cm^{-3}$

Operating frequency : $f = 10GHz$

(i) Compute the electron drift velocity

(ii) Calculate the current density

(iii) Estimate the negative electron mobility. 6

(c) What is the significance of negative resistance ?

7. Write short notes on : 10×2=20

(a) Isolator

(b) TRAPATT diode
