Printed Pages : 4

EEC603

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 131603

Roll No.

B. Tech.

(SEM. VI) THEORY EXAMINATION, 2014-15

MICROWAVE ENGINEERING

Time : **3** Hours] [Total Marks : **100**

Note : Attempt all the questions.
Each question carries equal marks.

1 Attempt any four parts of the following : **5×4=20**

(a) What are waveguides ? Explain the following terms :
   (i) Phase velocity
   (ii) Group velocity
   (iii) Cut-off wavelength.

(b) Derive the field distribution of TE10 mode in rectangular waveguide and draw its field pattern.

(c) Show that TE01 and TM10 modes do not exist in rectangular wave guide.

(d) What is microstrip line ? How does its characteristic impedance change with change in width to height ratio.

(e) A rectangular wave guide has a cross sectional area 2.29 cm × 1.45 cm and the operating frequency is 9.0 GHz. Calculate the value of (a) free space wavelength, (b) cut off frequency, (c) cut off wave length.

(f) Define quality factor of a cavity resonator. Derive expression for quality factor Q of a rectangular cavity resonator.

2 Attempt any four parts of the following : **5×4=20**

(a) What do you mean by microwave passive devices ? Describe E-plane tee, H-plane tee and Magic tee.

(b) What are S-parameters ? Why are they used at microwave frequencies to describe multiport network ?

(c) Describe rotary-vane attenuator. Show that its [S] matrix is given by

$$[S]=\begin{bmatrix} 0 & \sin^2\theta \\ \sin^2\theta & 0 \end{bmatrix}$$

(d) What is a phase shifter ? Describe a rotary phase shifter and explain its principle.

(e) Show that the scattering matrix of four port circular using magic tees is

$$[S]=\begin{bmatrix} 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

(f) With support of figures explain the working of an isolator.

3 Attempt any two parts of the following : **10×2=20**

(a) A two cavity klystron amplifier has the following specifications : Beam voltage = 900 V, Beam current = 30 mA, frequency = 8GHz, gap spacing in either cavity = 1 mm, spacing between centers of cavities = 4cm and effective shunt impedance = 49 $k\Omega$. Determine

(i) Electron velocity

(ii) D.C. transit time of electron

(iii) Input voltage for maximum output voltage

(iv) Voltage gain in dB

(b) By means of an appropriate diagram explain the operation of a reflex klystron. Calculate the modulated velocity of electron if the electron enters the cavity at the instant when the R.F. signal is at its negative peak. Assume cavity gap to be 2mm and the frequency of R.F. signal to be 9 GHz with peak to peak value of 10 mV and V_a = 1000 V.

(c) With support of figure explain the working of TWT.

4 Attempt any two parts of the following : **10×2=20**

(a) Give the construction of tunnel diode. Explain its volt-ampere characteristics.

(b) Explain the construction, fabrication and domain formation of Gunn diode.

(c) Explain IMPATT and TRAPATT diodes and compare their performance.

5 Attempt any two parts of the following : **10×2=20**

(a) Explain :

(i) Thermocouple detector

(ii) Bolometer mount technique

(iii) Calorimeter wattmeter technique

(iv) Slotted line carriage and its importance in μW test bench.

(b) Discuss the salient features of microwave measurements. Describe a voltage standing wave ratio (VSWR) meter.

(c) What do you mean by insertion loss and attenuation ? Discuss any one method for measurement of attenuation using μ wave test bench.