2016

M.Sc.

4th Semester Examination

ELECTRONICS

PAPER—ELC-401

Full Marks : 50

Time : 2 hours

The figures in the right-hand margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Illustrate the answers wherever necessary.

(Microwave Devices and Circuits)

Answer Q. No. 1 and any *three* from the rest.

1. (a) Write an expression for the resonance frequency f_r of an air filled rectangular cavity resonator and hence draw the graphical representation of 'f_r' versus length of the cavity 'd'.

(b) What is quasi TEM ? Explain with an example.

(c) Consider a rectangular, a circular and a spherical cavity resonator of same volume. Compare Q-factor of them with physical explanations.

(d) Define coupling coefficient and directivity of a directional coupler.

(e) A 75Ω transmission line has a loss of 1·5 dB/m. A section of line is used to make a series resonant ckt at 1 GHz and the velocity of the voltage on the line is 2×10^8 m/s. Find the Q-factor and 3dB band width of the resonant circuit.   2×5

2. (a) Discuss why conventional tubes like triodes, tetrodes can not generate microwave power.

(b) Describe how velocity modulation is achieved in a two cavity Klystron and derive and expression for it.

(c) How does a reflex Klystron differ from a two cavity Klystron ?   2+6+2

3. (a) Explain low negative resistance region of tunnel diode is obtained.

(b) Find an expression for the input impedance of the tunnel diode. 4+6

4. (a) How a slot line differs from a microstrip line?

(b) Describe the role of dielectric in the design of microstrip line. Derive Q-value of a microstrip line.

(c) In a microstrip line quartz (E_r=2·56) is used as a substrate material and if the line has an allenuation of 20 dB and Q = 10, calculate the operating frequency of the line. 2+(2+2)+4

5. (a) Show that for a loss less microwave device, the scattering matrix must hold unitary property.

(b) A two port network is having following scattering matrix

$$[S] = \begin{bmatrix} ·25 \angle 0 & ·75 \angle -45° \\ .75 \angle 45° & ·2 \angle 0° \end{bmatrix}$$

Determine whether the network is lossless and reciprocal.

If port-2 is terminated with matched load what is the return loss seen at port-1? If port-2 is terminated with short circuit what is the return loss seen at port-1?

4+(2+2+2)

6. (a) State and explain Floquel's theorem.

   (b) Explain the operation of Helix Travelling Wave tube.

   (c) A helix travelling wave tube has the following parameters.

   Beam voltage V_0 = 3kV

   Beam Current I_0 = 30 mA

   Characteristic impedence of helix Z_0 = 8Ω

   Circuit length N = 50.

   Frequency f = 8 GHz.

   Determine (i) the gainparameter C and

                 (ii) the output power gain A_p in decibels.

                                 2+4+(2+2)

Internal Assessment — 10