

2015

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) How a Tunnel diode may be used in monostable, bistable and astable mode in a circuit ?
- (b) Show that for TE_{10} mode in rectangular waveguide the electric field along the x direction (E_x) is always zero.

(Turn Over)

- (c) Draw the small signal ac equivalent circuit of FET and show its various parameters.
- (d) Draw the I-V characteristics of Gunn diode. Explain why the negative resistance is essential for generation of oscillation.
- (e) Write expressions for the characteristics impedance and effective dielectric constant of a microstrip line.
2. (a) Draw the equivalent circuit of a circular cavity resonator.
- (b) Show that the quality factor 'Q' of such a cavity resonator is given by

$$Q = \frac{\omega \mu V}{2R_s s}$$

where symbols have their usual significance.

- (c) A cavity resonator of intrinsic Q 400 is coupled to an external network of Q value 200. Find the loaded Q of the cavity after derivation of necessary formula.

1+4+5

3. (a) Draw the schematic diagram of a two cavity Klystron. Describe the velocity modulation process with the help of applegate diagram. Derive an equation for the velocity modulation.
- (b) Find an expression for the bunching parameter of a Klystron. (2+2+2)+4
4. (a) How a slot line differs from a microstrip line ?
- (b) Discuss the role of dielectric in the design of a microstrip line. Derive the Q-value of a microstrip line.
- (c) In a microstrip line Alumina of dielectric constant 9.7 is used as substrate. If the line carries microwave at a frequency 10 GHz and effective attenuation is 20dB, calculate Q-value of the line. 2+(2+2)+4
5. (a) Draw a simplified schematic diagram of a helix travelling wave tube and explain its operation.
- (b) A travelling wave tube operates under the following parameters :
- Beam voltage $V_0 = 3 \text{ kV}$
- Beam current $I_0 = 30 \text{ mA}$

Characteristics impedance of Helix $Z_0 = 8 \Omega$

Circuit length $N = 50$

frequency $f = 8 \text{ GHz}$

Determine (i) The gain parameter C and

(ii) The output power gain A_p in dB.

5+5

6. (a) Describe the two valley model of n type GaAs material.

(b) Deduce an expression to show that the electron mobility in the upper valley is less compared to lower valley. Describe how negative resistance region is obtained in its I-V characteristics curve.

(c) Draw the equivalent circuit of a Tunnel diode and hence find the resonant frequency of the diode.

2+5+3

Internal Assessment — 10
