M.Sc. 4th Semester Examination, 2013

ELECTRONICS

(*Microwave Devices and Circuits*)

(Theory)

PAPER – ELC-401

Full Marks : 50

Time : 2 hours

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

The figures in the right-hand margin indicate marks

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

Illustrate the answers wherever necessary

1. (*a*) Why two-cavity Klystron oscillators are not usually constructed ?

    (*b*) Write down the scattering matrix for an ideal 4-port circulator.

(c) Why microstrip transmission line is preferred over any other type of transmission line ?

(d) Why ferrite devices are called non-reciprocal devices ?

(e) Prove that three ports of a loss-less passive Tee-junction, when reciprocal in nature, can not be matched simultaneously.   2 × 5

2. (a) Why the conventional tube like triode, tetrode can not generate microwave power ?

(b) Describe how velocity modulation of a beam is obtained in Klystron amplifier and hence derive and expression for it.

(c) How does a reflex klystron differ from Klystron amplifier ?   2 + 6 + 2

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

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

(Continued)

(c) In a microstrip line, duroid ($\varepsilon_r = 2.56$) is used as a substrate material and if the line has an attenuation of 20 dB and $Q = 10$, calculate the operating frequency of the line. $2 + 4 + 4$

4. (a) Draw the schematic diagram of a GaAs MESFET and its small signal equivalent circuit. State the intrinsic and extrinsic elements of a MESFET.

(b) In GaAs : MESFET has the following parameters :

$$R_G = 6\ \Omega;\quad R_i = 2\ \Omega;\quad g_m = 60\ \text{mmho};$$
$$R_d = 400\ \Omega,\ R_s = 2\ \Omega,\ C_{gs} = 0.5\ \text{pF}.$$

Calculate :

(i) The cut off frequency.

(ii) The maximum operating frequency. $4 + 2 + 4$

5. (a) Discuss the physical structure and principle of operation of a Quantum Well Injection Transit Time (QWITT) diode.

(b) What are the advantages of MICs over discrete circuits ? State the basic properties required for an ideal (i) substrate material and (ii) conductor material used in MICs.   5 + 5

6. (a) Draw a neat sketch of a magic-tee and state its transportation characteristics.

(b) Explain the construction and working principle of an IMPATT diode.

(c) Explain the operation of a directional coupler and define (i) coupling coefficient (ii) directivity.   4 + 2 + 4

[*Internal Assessment* : 10 Marks]

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