Sixth Semester Examination – 2007

MICROWAVE ENGINEERING

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which is compulsory and any ***five*** *from the rest.*

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

1. Explain the following in brief : 2×10

   (a) What are the three most common types of guiding structures that support TEM waves ?

(b) Where do the minima of the voltage standing wave on a lossless line with a resistive termination occur, if $R_L > R_0$?

(c) What is meant by a cut-off frequency of a waveguide ?

(d) Which mode is the dominant mode in a circular waveguide ?

(e) What is the significance of the term 'critical magnetic field' as it is used in connection with magnetrons ?

(f) What is the purpose of directional couplers ?

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

(h) Which antenna system is suitable for microwave communication ?

(i) On what factors the selection of an antenna depends ?

(j) What is an elevated duct ?

2. (a) Find the expression for characteristic impedance of a short-circuited and open-circuited line. Find also the values of reflection coefficient and SWR under such conditions. 6

(b) A long transmission line carries 5 kW at 500 V to a matched load –

(i) What is the reflection coefficient at the load end, when a load of impedance $200 + j100\ \Omega$ is connected ? 6

(ii) What is the reflection coefficient at the load end when the load is disconnected ? 4

3. (a) State the boundary conditions to be satisfied by E_z for TM waves in a rectangular waveguide. Which TM mode has the lowest cut-off frequency of all the TM modes in a rectangular waveguide ? 4

(b) In an air-filled square waveguide with dimensions a =1.2 cm, $E_x = -10 \sin(2\pi y/a)$ $\sin(\omega t - 150\ z)$ V/m.

(i) What is the mode of propagation ?

(ii) Find the cut-off wavelength.

(iii) Calculate the frequency of operation. 6

4. (a) (i) Are the field patterns in a cavity resonator travelling waves or standing waves ? How do they differ from those in a waveguide ?

(ii) What are the modes of the lowest orders in a rectangular cavity resonator ? 5

(b) What field components exist in a circular cylindrical waveguide operating in the dominant mode ? 5

5. (a) With sketches, describe waveguide matching terminations and attenuators. 6

(b) In a magic Tree, if the waves are input to both ports of the main guide, then determine the output in E and H arm of the following cases :

(i) Waves of equal amplitude and phase are incident.

(ii) Waves of equal amplitude but opposite phase are incident. 4

6. (a) With the help of a circuit diagram explain how Gunn diode can be used as an oscillator and an amplifier. 6

(b) A GaAs Gunn diode has a drift length of 10 μm. Determine the frequency of oscillation. 4

7. (a) Describe, in brief, the space wave propagation. 5

(b) Explain the term 'fading'. Describe different types of fading of space wave signals. 5

8. With neat sketches discuss different types of horn antenna. Discuss the application of the horn and give its advantages. 10