

**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?

P.T.O.

- (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,  $E_x = -10 \sin(2\pi y/a) \sin(\omega t - 150z)$  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 Tee, 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  $\mu\text{m}$ . 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