Total No. of printed pages = 2

2022

ECE 181701

Roll No. of candidate | | | | | | | | | | |

2021

B.Tech. 7th Semester End-Term Examination

ECE + ETE

MICROWAVE ENGINEERING

(New Regulation w.e.f. 2017-18) &

(New Syllabus w.e.f. 2018-19)

Full Marks – 70 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer any *seven* questions.

1. Find the relation between reflection and transmission co-efficient of a transmission line if it is not terminating in its characteristic impedance. (10)

2. The SWR of a 50 Ω transmission line is 1.8 when the line is loaded. When the load is shorted, the voltage minimum shifts by 6 cm towards the load from its previous position. If the distance between two successive voltage minima is 15 cm, then determine the load impedance, complex reflection coefficient at the load and line impedance and admittance at a distance of 25 cm from the load. (10)

3. (a) What are the different mismatch losses in Transmission lines? Define them all in terms of S-parameters. (4)

   (b) Using the Smith Chart, find the location and length of the short circuited stub required for a line of $Z_0 = 50\ \Omega$, SWR = 3. When the load is shorted, the shift in minima is 0.2λ towards the generator. (6)

4. Starting from the Maxwell's equations, derive the field equations of TM waves cylindrical waveguide. (10)

[Turn over

5. What do you mean by dominant mode? Which mode is called the dominant mode in RW and why? RW having a cross-section of 22.86 mm × 10.16 mm is filled with a lossless dielectric of relative permittivity 4.7. The x component of the magnetic field and z component of electric field are expressed as

$$H_x = 2\sin\frac{\pi x}{a}\cos\frac{2\pi y}{b}\sin(30\pi\times10^9 t-\beta z)\text{A/m} \quad \text{and} \quad E_z = 0 \quad \text{V/m, respectively.}$$

Calculate the (i) mode of operation, (ii) cut-off frequency, (iii) phase constant, (iv) propagation constant, and (v) intrinsic impedance. What are the other modes that can propagate through it at 7.5 GHz? (10)

6. What do you mean by cavity resonator? Find the expressions for the resonance frequency and the dominant mode of a RW cavity resonator for the TE and TM modes. Also write the standing wave field equations. (10)

7. (a) Draw the field patterns for all the dominant modes of TE and TM waves of both RW and CW. What are the different methods of exciting the dominant modes in RW and CW. (5)

(b) An air-filled RW of dimensions a=22.86 mm and b= 10.16 mm transports energy at a rate of 3 mW, using the dominant mode propagation. If the frequency of operation is 9 GHz, determine the peak value of the electric field in the waveguide. (5)

8. (a) Show that for a two port network terminated with an unmatched load, the reflection coefficient is not the same as S_{11}. (5)

(b) A four port network has the following scattering matrix :

$$\begin{bmatrix} 0.6\angle45^\circ & 0.8\angle60^\circ \\ 0.8\angle60^\circ & 0.6\angle45^\circ \end{bmatrix}$$

What is the reflection coefficient seen at port 1 if port 2 is shorted? (5)

9. (a) With suitable diagram, describe the operation of a cylindrical magnetron and derive the equation of Hull cut-off magnetic field and voltage. (5)

(b) What is Gunn Effect? Describe the RWH theory to explain Gunn Effect. (5)