Total number of printed pages–4

53 (EC 601) MCEN

2021

MICROWAVE ENGINEERING

Paper : EC 601

Full Marks : 100

Time : Three hours

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

*Answer **any five** questions.*

1. *(a)* Derive the electromagnetic field equations in rectangular waveguide for TE mode. Hence obtain the cut-off frequency for TE10 mode in terms of waveguide dimensions.

   (b) Explain why TE10 is called dominant mode. (14+3)+3=20

2. *(a)* Define the cut-off frequency and guide wavelength in a rectangular waveguide.

Contd.

(b) Derive the expression of the guide wavelength in terms of the relevant parameters.

(c) Determine the values of the cut-off frequency, characteristic wave impedance and the guide wavelength in hollow rectangular waveguide with inside dimensions $2{\cdot}286 \times 1{\cdot}00\,cm$ at 9 *GHz* for the dominating mode.

6+5+9=20

3. (a) Derive an expression for the resonant frequency of a rectangular cavity $(a \times b \times l)$ with $a > b < l$ and hence obtain the dominant mode of resonance.

(b) Define '*Q*' factor of a cavity. Discuss the steps involved in determining '*Q*-factor' of the cavity. Distinguish between 'loaded *Q*' and 'unloaded-*Q*' of the cavity. 10+(2+4+4)=20

4. (a) Discuss the working principle of a 'Magic-T'.

(b) Obtain the scattering matrix equation of a 'Magic-T' by using the necessary properties of the scattering matrix.

(c) Explain why 'Scattering Matrix' representation of a microwave network is preferred over *Z*-matrix or *Y*-matrix representation. 6+8+6=20

5. (a) Describe an ideal 'Directional Coupler' and write its 'Scattering Matrix'. Define 'Coupling' and 'Directivity' in the context of a directional coupler.

(b) Explain the design of a 2-hole directional coupler in rectangular waveguide version for a given coupling. Mention the principal shortcoming of such a directional coupler. Discuss how this shortcoming can be overcome. 12+8=20

6. (a) Explain the slotted line method for the measurement of unknown impedance.

(b) Describe the procedure for measuring *(i)* VSWR (<10) and *(ii)* VSWR (>10) using a VSWR meter in a microwave bench. 10+10=20

7. *(a)* Explain the working principle of a reflex Klystron oscillator.

(b) Explain what is meant by 'Velocity Modulation' and how this phenomenon is used in the operation of a Klystron tube.

(c) Draw the power *vs* repeller voltage and frequency *vs* repeller voltage characteristics of a reflex Klystron. Explain qualitatively. 8+6+6=20