

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 $2.286 \times 1.00 \text{ cm}$ at 9 GHz for the dominating mode.

$$6+5+9=20$$

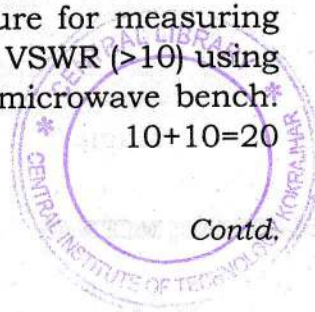
3. (a) Derive an expression for the resonant frequency of a rectangular cavity ($a \times b \times l$) with $a > b < l$ and hence obtain the dominant mode of resonance.

(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

