## CENTRAL INSTITUTE OF TECHNOLOGY, KOKRAJHAR (Deemed to be University, MHRD, Govt. of India) KOKRAJHAR:: BTAD:: ASSAM :: 783370 END – SEMESTER EXAMINATION

Session: July-December 2024 Semester: 7<sup>th</sup> Time: 3

Time: 3Hr Full Marks: 100

Course Code: UECE711A

Course Title: Microwave Theory and Techniques

## Answer any five questions 5 X 20=100

- 1. (a) Derive the electromagnetic field equations in rectangular waveguide for TM mode.
  - (b) Determine the expression of the wave impedance.
  - (c) Explain why  $TM_{10}$  or  $TM_{01}$  is not possible in rectangular waveguide. (14+3+3)

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- (a) Derive the expressions of the electromagnetic field equations in cylindrical waveguide with circular cross section for TE mode.
  - (b) Determine the expression of the wave impedance (15+5)
- 3. (a) Discuss the various considerations in choosing the cross sectional dimensions of a rectangular waveguide
  - (b) Given  $E_y = A \sin \frac{\pi x}{a} e^{-j\beta z}$  v/m to be the electric field in the transverse cross-section of

a hollow metallic rectangular waveguide with inside dimensions as  $'a \times b'$ . Derive the expression for the power transported in the dominant mode.

- (c) If a = 2.286cm, b = 1.0cm ad A = 2V/m then calculate the power in the dominant mode at 9 GHz. (7+8+5)
- 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 .

(8+8+4)

5. (a) Describe the operating principle of an ideal 'Directional coupler' and write its 'Scattering Matrix'.

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- (b) Define 'Coupling' and 'Directivity' in the context of a directional coupler.
- (c) Describe the operating principle of precision type variable attenuator. (8+4+8)
- 6. (a) Explain the slotted line method for the measurement of unknown impedance.
  - (b) Describe the procedure for measuring VSWR (>10) using a VSWR meter in a microwave bench. (10+10)
- 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.
    (6+6+8)

