

Con. 2857-09.

(REVISED COURSE)

(3 Hours)

[Total Marks : 100]

Microwave & Fiber Optic Communication

- N.B. :** (1) Question No. 1 is **compulsory**.
 (2) Attempt any **four** question out of remaining **six** questions.
 (3) Assume any **suitable** data wherever **required** but **justify** the same.

1. Attempt any **four** from the following :-

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- Compare the optical fiber communication with microwave communication system.
- Describe in brief direct band gap and indirect bandgap semiconductors.
- Why TM_{01} or TM_{10} mode is not possible in rectangular waveguide ? Calculate the cutoff frequency for TE_{10} , TE_{11} and TM_{11} modes for a rectangular guide having dimension 4cm x 2cm.
- What is dispersion in optical fibers ? How does it affect the performance of the fiber optic link.
- State and explain the symmetry property of S-matrix.

2. (a) Obtain an expression for the modulated velocity of the electron beam in klystron amplifier in terms of the beam coupling co-efficient β_1 and the average transit angle θ_g . 12

(b) A two cavity rlystron amplifier operating at 5GHz has the following parameters : 8

$$V_0 = 800 \text{ V}, I_0 = 20 \text{ mA}$$

Gap spacing $d = 1\text{mm}$, spacing between two cavities $L = 4\text{cm}$. Find -

- the electron velocity just leaving the Cathode
- the gap transit angle
- the beam coupling co-efficient
- the dc transit angle between the cavities.

3. (a) Describe different types of modes that are supported by an optical fiber. What is the significance of cutt off no. of fiber ? 6

(b) Calculate the cross sectional area of a multimode step index fiber with a V no., $V = 100$ and a N.A. = 0.3 This fiber will be used in a data link with a $0.82 \mu\text{m}$ LED (Take $n_1 = 1.458$) 4

(c) With the help of a neat schematic, explain the Modified Chemical Vapour Deposition (MCVD) Technique of fabricating an optical fiber. 10

4. (a) With the help of suitable diagrams, explain the mechasnim of operation of an 8 cavity magnetron operating in the dominant π mode. How are the various modes separated in a magnetron ? 10

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- (b) A 400 kW cylindrical magnetron operating at x-band has the following set of 10 parameters :-

Anode Voltage $V_{dc} = 32$ kV, Beam current $I_{dc} = 84$ A

Radius of cathode cylinder (ξ_c) = 6 cm

Radius of anode cylinder (ξ_a) = 12 cm

Magnetic flux density (B) = 0.01 Wb/m²

Calculate : (i) The cyclotron angular frequency

(ii) The cut off magnetic flux density for a fixed V_{dc}

(iii) The cut off voltage for a fixed B_0 and

(iv) The efficiency (η)

5. (a) Define quantum efficiency and responsivity of a photodetector. Derive an expression 10 for the responsivity of an intrinsic photodetectors in terms of the quantum efficiency of the device and the wavelength of the incident radiation.

- (b) A continuous 12 km long optical fiber link has a loss of 1.5 dB/km. 10

(i) What is the minimum optical power that must be launched into the fiber to maintain an optical power level of 0.3 mW at the receiving end.

(ii) What is the required input power if the fiber has a loss of 2.5 dB/km.

6. (a) Differentiate between :- 10

(i) TWTA and Klystron

(ii) IMPATT diode and Gunn diode

- (b) Distinguish between spontaneous emission and stimulated emission. How 10 stimulated emission is achieved in LASER.

7. Write short notes on any **four** :- 20

(a) Cavity Resonator

(b) Multiplexing techniques in fiber optic system

(c) Measurement of microwave power

(d) Link power budget

(e) Microwave ferrite devices

(f) Splices and connectors in optical fiber.