

**MICROWAVE ENGINEERING**

(Electronics and Communication Engineering)

Time: 3 hours

Max Marks: 70

Answer any FIVE questions  
All questions carry equal marks

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- 1 The dominant mode TE<sub>10</sub> is propagated in a rectangular waveguide of dimensions a = 6 cm and b = 4 cm. The distance between a maximum and a minimum is 4.47 cm. Determine the signal frequency of the dominant mode.
- 2 (a) Explain the differences between strip line and microstrip line.  
(b) Draw the circular resonator cavity diagram and derive equation for resonator cavity.
- 3 Draw the E-plane Tee diagram, equivalent circuit and field diagram. Explain how power is coupled into port 3.
- 4 Show that the S-matrix of a directional coupler is given by:

$$[s] = \begin{bmatrix} 0 & \alpha & 0 & j\beta \\ \alpha & 0 & j\beta & 0 \\ 0 & j\beta & 0 & \alpha \\ j\beta & 0 & \alpha & 0 \end{bmatrix}$$

Where  $\alpha^2 + \beta^2 = 1$

- 5 (a) Explain the gain bandwidth product limitation & transit angle effects in conventional tubes at microwave frequencies.  
(b) A reflex klystron operates under the following conditions:  
V<sub>0</sub> = 900 V, L = 1 mm, R<sub>sh</sub> = 25 kΩ, e/m = 1.759 × 10<sup>11</sup> (MKS system), f<sub>r</sub> = 9 GHz. The tube is oscillating at f<sub>r</sub> at the peak of n = 2 mode or 1¾ mode. Assume that the transit time through the gap & beam loading can be neglected.  
(i) Find the value of repeller voltage V<sub>r</sub>.  
(ii) Find the D.C current necessary to give a microwave gap voltage of 100 V.  
(iii) What is the electronic efficiency under this condition?
- 6 (a) What is CFA? State the applications of CFA.  
(b) Explain the operation of TWT amplifier with a neat diagram.
- 7 (a) Write down basic requirements for two-valley theory of Gunn diode. Explain.  
(b) What is the main idea behind obtaining negative resistance in a Gunn diode?
- 8 (a) Explain the method to measure VSWR and reflection co-efficient.  
(b) Describe the measurement of impedance using slotted line and Smith chart.

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