## PROBLEM

1. If the device operates at 3GHz with an anode voltage of 40kV and an efficiency of 70%, determine the output power if the input DC power is 1 MV.

Solution:

Given: Frequency = 3GHz
Anode voltage = 40kV.
Efficiency = 70%
I/P DC power = 1MV = 1000 kW

To find: O/P power

O/P power = Efficiency × I/P power
= 0.7 × 1000
= 700kW.

2. The input power to the sum arm of an ideal matched magic-T is 1W. Find output power from the other arms when matched terminated.

Soln:

Given: I/P power = 1W.

Magic Tee Behavior:

- When I/P at the sum port:
  * O/P power splits equally b/w port 1 & port 2
  * No power comes out of port 4.

So:

$P_1 = 0.5W$.

$P_2 = 0.5W$.

$P_4 = 0W$.

3. If the repeller voltage is set to -600V, and electron path length is 1.5 mm, estimate the electron transit time in nanoseconds.

Solution:

Given: Repeller voltage = -600V

$D = 1.5mm = 1.5 \times 10^{-3} m$.

Electron charge $e = 1.6 \times 10^{-19} C$.

Electron mass $m = 9.1 \times 10^{-31} kg$

Step 1: Electron velocity:

$$\frac{1}{2}mv^2 = eV \Rightarrow v = \sqrt{\frac{2eV}{m}}$$

$$v = \sqrt{\frac{2 \times 1.6 \times 10^{-19} \times 600}{9.1 \times 10^{-31}}}$$

$$= \sqrt{\frac{1.9 \times 10^{-16}}{9.1 \times 10^{-31}}}$$

$$v \approx 1.45 \times 10^{7} m/s$$

Step 2: Transit time

$$t = \frac{d}{v}$$

$$= \frac{1.5 \times 10^{-3}}{1.45 \times 10^{7}} = 1.03 \times 10^{-10}$$

$$\frac{1.5}{1.45} = 1.03$$

$$t \approx 0.103 ns$$

4. If the input power is 80W, and coupling factor is 10dB, determine the power coupled to auxiliary port.

Solu:

Given: I/P power = 80W

Coupling factor = 10dB.

$$P_{coupled} = P_{input} \times 10^{-\frac{\text{coupling factor}}{10}}$$

$$= 80 \times 10^{-\frac{10}{10}} = 80 \times 10^{-1}$$

$$\boxed{P_{coupled} = 8W}$$

5. A semiconductor device exhibits a unique current-voltage characteristics, with a peak current of 3mA at forward voltage of 0.07 V and a valley current of 0.8 mA at a voltage of 0.2V. Determine the peak-to-valley current ratio (PVCR) of this device.

Solu:

Given: Peak current $I_p = 3mA$

Valley current $I_v = 0.8mA$.

$$PVCR = \frac{I_p}{I_v}$$

$$= \frac{3}{0.8}$$

$$\boxed{PVCR = 3.75}$$