EE210: Analog Electronics - Quiz 2

NAME (in capital)	Roll No

Time: 15 minutes

1) : Consider the circuit in Fig. 1. $I_B = 4mA$, $V_{in} = 0$, $R = 0.5k\Omega$. The I-V characteristics of the non-linear element, E is given by $I_N = \alpha {V_N}^2$, for $V_N \geq 0$, and $I_N = 0$ for $V_N < 0$, where $\alpha = 2mA/V^2$.

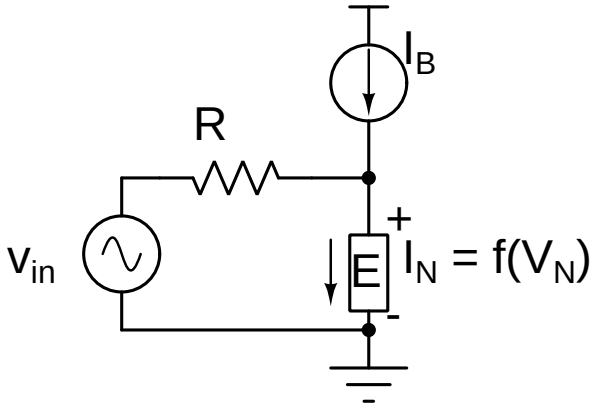


Fig. 1. Problem 1

a) : Find the quiescent current through E. **[4]**

KCL @ V_N $\Rightarrow$ $I_B = \alpha V_N^2 + \frac{V_N}{R}$

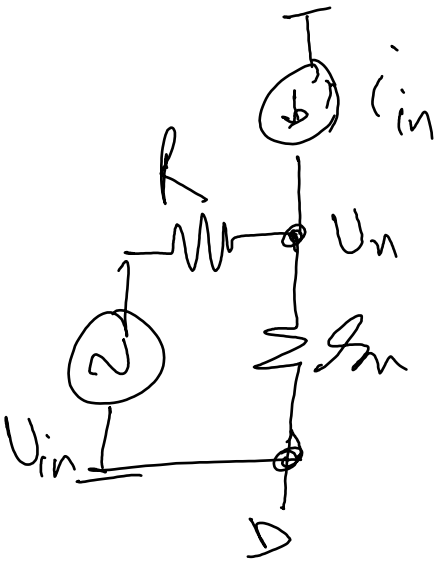
$\Rightarrow 4m = 2m V_N^2 + 2m V_N$

$\Rightarrow V_N^2 + V_N - 2 = 0$

$\Rightarrow V_N = 1V$ or $(-2V)$ (Not possible as per condition)

$\therefore I_N = 2mA$

b) : Assume $I_B = 4mA + 0.2mA\sin(\omega t)$ and $v_{in} = 100mV\sin(\omega t)$. Find the total voltage across the non-linear element. **[6]**



$$g_n = \frac{1}{(\partial I/\partial V)_{I_N = 2mA}} = \frac{1}{2\alpha V_N} = 0.25k\Omega$$

$$\therefore V_n = \frac{V_{in}\, g_n}{R + g_n} + \frac{i_{in}\, R g_n}{R + g_n}$$

$$= V_{in}\frac{0.25}{0.75} + i_{in}\left(\frac{0.25 \times 0.75}{0.75} - \frac{1}{3}\right)$$

$$= \left(\frac{100m}{3} + \frac{100m}{3}\right)\sin(\omega t)$$

$$= \frac{200}{3}mV\sin(\omega t)$$

$$\therefore V_N = 1V + 66.67mV\sin(\omega t)$$