EE210: Analog Electronics - Quiz 3

NAME (in capital)	Roll No

Time: 15 minutes

1) : Consider the circuit in Fig. 1. A three terminal non-linear element has been used, whose terminals are defined in the inset. The element has the following characteristics.
$I_D = I_S = \alpha V_{GS}^2$ for $V_{GS} \geq 0$ and $V_{DS} \geq 0$. $I_D = I_S = 0$ otherwise.

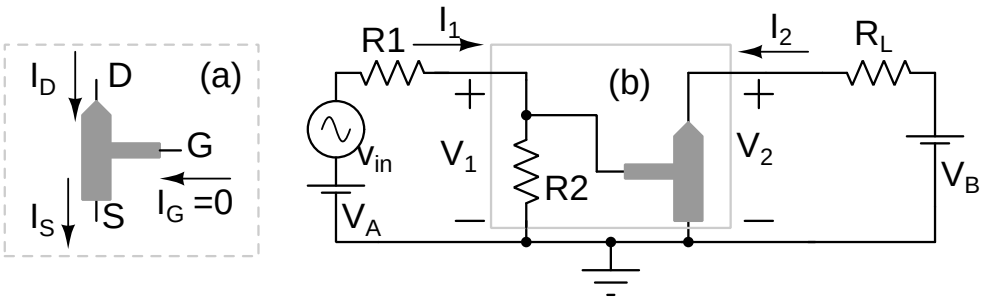


Fig. 1. Problem 1

a) : Assume $V_A = 2\,V$, $V_B = 5\,V$, $R_1 = R_2 = 2\,k\Omega, \alpha = 1\,mA/V^2$ and $RL = 2\,k\Omega$. Find the small-signal two-port y-parameters of the network within the box (in Fig. 1(b)) and sketch the small-signal two-port network. **[6]**

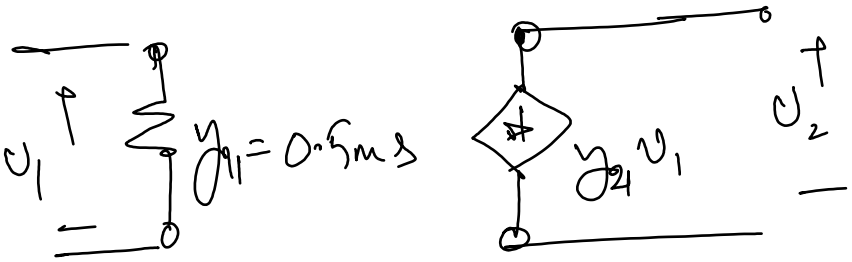
$V_1 = \frac{V_A}{2} = 1V \quad I_2 = \alpha V_1^2 = 1mA$

$V_2 = V_B - I_2 R_L = 3V$

$I_1 = \frac{V_1}{R_2} \qquad I_2 = \alpha V_1^2$

$\therefore y_{11} = \frac{\partial I_1}{\partial V_1} = \frac{1}{R_2} = 0.5mS \qquad y_{12} = 0$

$y_{21} = \frac{\partial I_2}{\partial V_1} = 2\alpha V_1 = 2mS \qquad y_{22} = 0$



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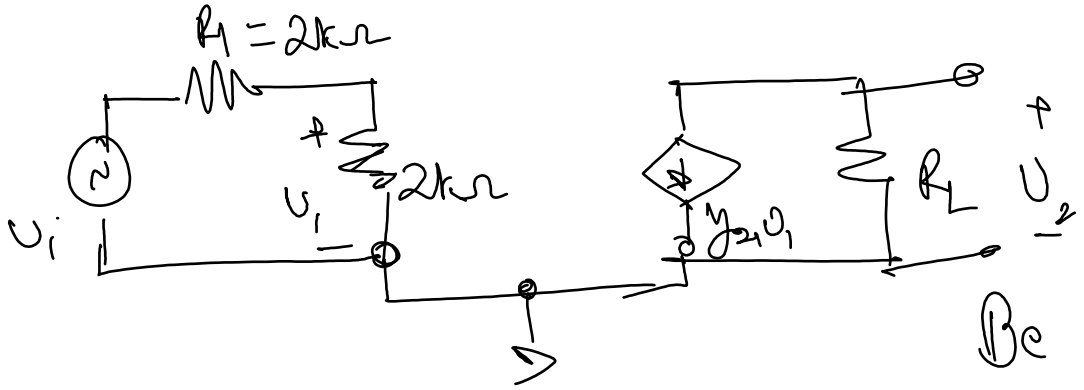
b) : If $v_{in} = 10mV\sin(\omega t)$, find the small signal voltage across V_1 and V_2. **[4]**



$V_1 = \frac{V_i}{2} = 5mV\sin(\omega t)$

Be mindful of the two connecting ports (with a short)

$V_2 = -y_{21} V_1 R_L = -2m \times 5mV\sin(\omega t) \times 2k$

$= -20mV\sin(\omega t)$

Be mindful of the -ve sign