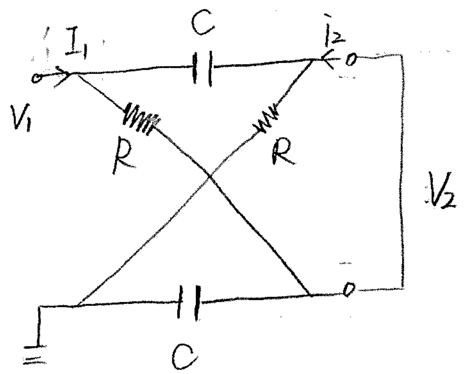
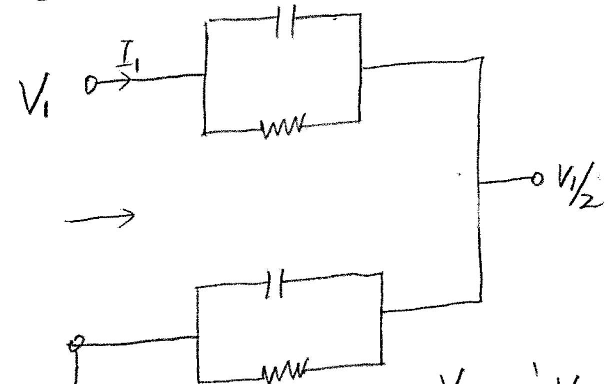
HW1 Solution

1. Every $T = 0.1\mu s$, the $C = 4pF$ is charged to 5V. This requires CV^2 energy, so the power is $f_c \cdot CV^2 = 10^7 \times 4 \times 10^{-12} \times 25 = 1mW$

2. when calculating Y_{11} and Y_{21}, the circuit becomes



$\Longleftrightarrow$



$V_2 = \frac{1}{2} V_1$

$$I_1 = \frac{1}{2}\left(sC + \frac{1}{R}\right) V_1$$

$$\Rightarrow Y_{11} = \frac{1}{2}\left(sC + \frac{1}{R}\right)$$

Also, $i_2 = \frac{V_2}{R} + sC(V_2 - V_1)$

And $V_2 = \frac{1}{2} V_1$

$$\Rightarrow Y_{21} = \frac{1}{2}\left(-sC + \frac{1}{R}\right)$$

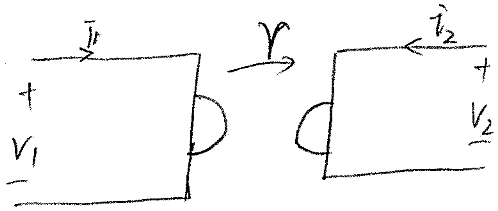
$$Y_{22} = Y_{11} = \frac{1}{2}\left(sC + \frac{1}{R}\right)$$

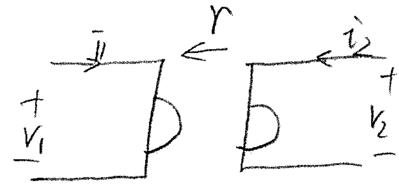
$$Y_{21} = Y_{12} = \frac{1}{2}\left(-sC + \frac{1}{R}\right)$$

so

$$Y = \begin{bmatrix} \frac{1}{2}\left(sC + \frac{1}{R}\right) & \frac{1}{2}\left(-sC + \frac{1}{R}\right) \\ \frac{1}{2}\left(-sC + \frac{1}{R}\right) & \frac{1}{2}\left(sC + \frac{1}{R}\right) \end{bmatrix}$$

3.





$V_1 = -r i_2$

$V_2 = i_1 r$

$$\Rightarrow \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 0 & -r \\ r & 0 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix}$$

$V_1 = i_2 r$

$V_2 = -r i_1$

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 0 & r \\ -r & 0 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix}$$

$$Z = \begin{bmatrix} 0 & -r \\ r & 0 \end{bmatrix} \quad \text{OR} \quad Z = \begin{bmatrix} 0 & r \\ -r & 0 \end{bmatrix}$$