**BRAC University**

# CSE-350 Quiz-04

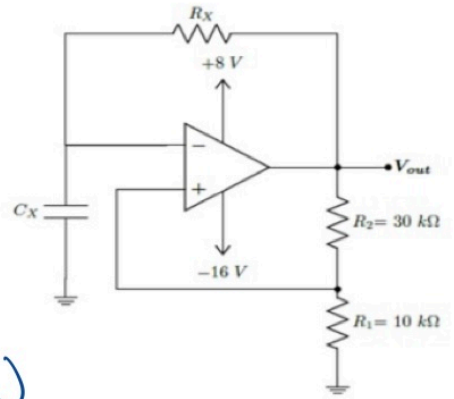
## Schmitt Trigger & Square Wave Generation

**Set-A** **Total – 20 marks** **Time – 20 minutes**

| Name - | Id - | Section - |
|---|---|---|

**Problem-1** **10 marks**

a) For the given circuit determine the duty cycle.
b) Plot the input and output on the same graph with proper labeling.




# Soln: (a)

$V_L = -16\,V$, $V_H = 8\,V$, $R_1 = 10k$, $R_2 = 30k$

$V_{UT} = \frac{R_1}{R_1+R_2} V_H = \frac{10}{10+30} \times 8 = 2\,V$

$V_{LT} = \frac{R_1}{R_1+R_2} V_L = \frac{10}{10+30} \times (-16) = -4\,V$

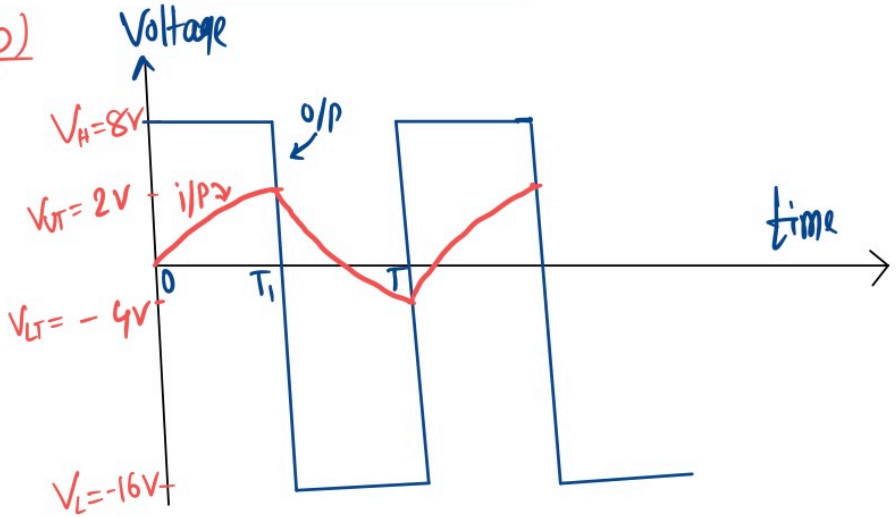
$T_1 = R_X C_X \ln\left(\frac{V_H - V_{LT}}{V_H - V_{UT}}\right) = R_X C_X \ln\left(\frac{8+4}{8-2}\right) = R_X C_X (0.69)$

$T_2 = R_X C_X \ln\left(\frac{V_L - V_{UT}}{V_L - V_{LT}}\right) = R_X C_X \ln\left(\frac{-16-2}{-16+4}\right) = R_X C_X (0.405)$

Duty cycle, $D = \frac{T_1}{T_1+T_2} \times 100\% = \frac{R_X C_X \times 0.69}{R_X C_X (0.69+0.405)} \times 100\%$

$D = 63.01\%$

(b)



**Problem-2** **10 marks**

Design a Non-inverting Schmitt trigger circuit having a center voltage of 2V and Hysteresis width of 2V. Assume $V_H = +4V$ and $V_L = -4V$. Draw the circuit and transfer curve with proper labeling.

$\Rightarrow$ given $\rightarrow V_{CTR} = V_S = 2V$, $V_{HYS} = 2V$, $V_H = 4V$, $V_L = -4V$

$$V_{UT} = V_{CTR} + \frac{V_{HYS}}{2} = 2 + 1 = 3V \qquad V_{LT} = V_{CTR} - \frac{V_{HYS}}{2} = 2 - 1 = 1V$$

$$V_{CTR} = V_S = \frac{R_1 + R_2}{R_2} V_{REF} = 2V$$

$$V_{UT} = -\frac{R_1}{R_2} V_L + \frac{R_1 + R_2}{R_2} V_{ref}$$

$$3 = -\frac{R_1}{R_2}(-4) + 2$$

$$1 = \frac{R_1}{R_2}(4)$$

$$\therefore \boxed{R_2 = 4R_1}$$

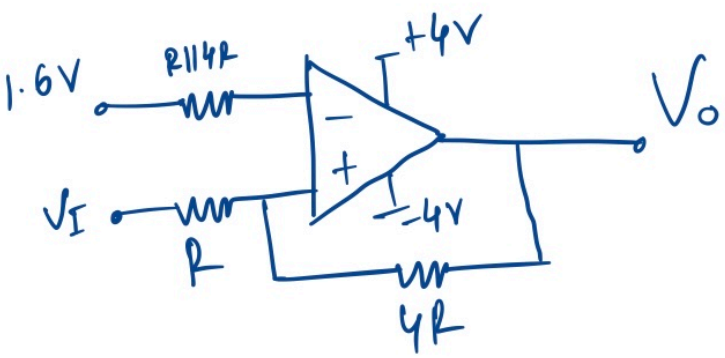
let $\rightarrow R_1 = R$, $R_2 = 4R$
(you can choose any value for R)

$$\frac{R_1 + R_2}{R_2} V_{ref} = 2$$

$$\Rightarrow \frac{R + 4R}{4R} V_{ref} = 2$$

$$\Rightarrow \frac{5}{4} V_{ref} = 2$$

$$\therefore \boxed{V_{ref} = \frac{8}{5} = 1.6V}$$




$\therefore$ Non-Inv. Schmitt trigger with applied voltage