ADIC
Assignment-1

Classmate Date: 20/11/22 Page:

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Set 1.3

Q1) Design an inverting schmitt trigger to have $V_{UT} = 2.5V$ and $V_{LT} = -2.5V$. If $V_{in} = 10V_{pp}$ and supply voltages $= \pm 15V$. Draw input output waveforms, hysterisis curve with voltages. Assume $R_L = 8.2k\Omega$. Draw neat circuit diagram.

→ Given: $R_L = 8.2k\Omega$
$V_{UT} = 2.5V$
$V_{LT} = -2.5V$
$V_{in} = 10V_{pp}$
Supply $V = \pm 15V$

Soln: $R_L = 8.2k\Omega$

$V_{sat} = 90\%$ of $V_{supply} = 90\% \times 15 = \frac{90 \times 15}{100}$

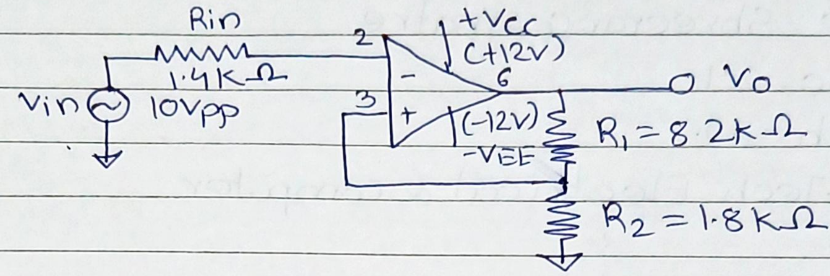
$\therefore V_{sat} = 13.5V$

$V_{UT} = \frac{R_2}{R_1 + R_2}(V_{sat}) \Rightarrow 2.5 = \frac{R_2}{R_1 + R_2}(13.5)$

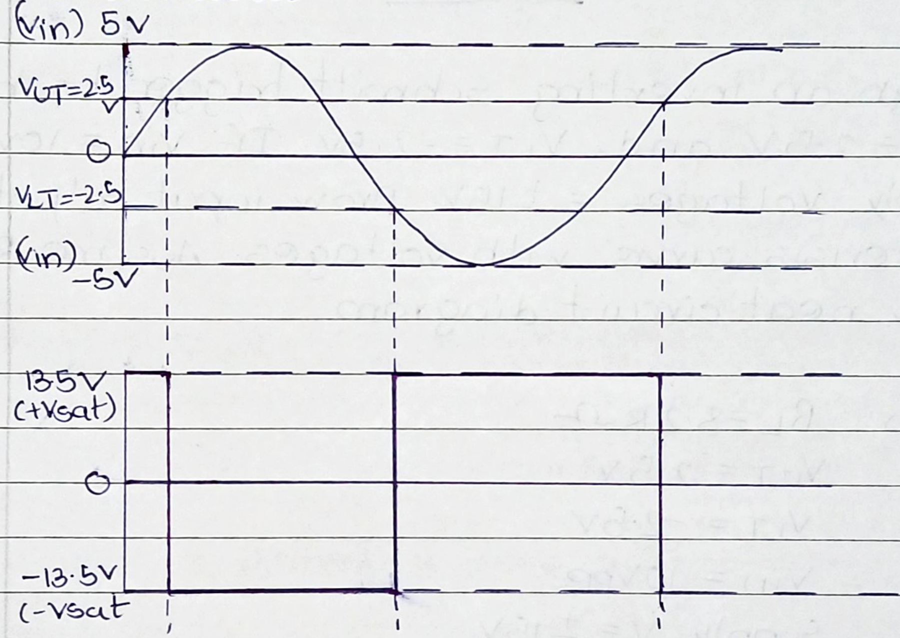
$\frac{2.5}{13.5}(R_1 + R_2) = R_2 \Rightarrow R_2 = 1.8k\Omega$

$R_{in} = R_1 \| R_2 = 1.4k\Omega$

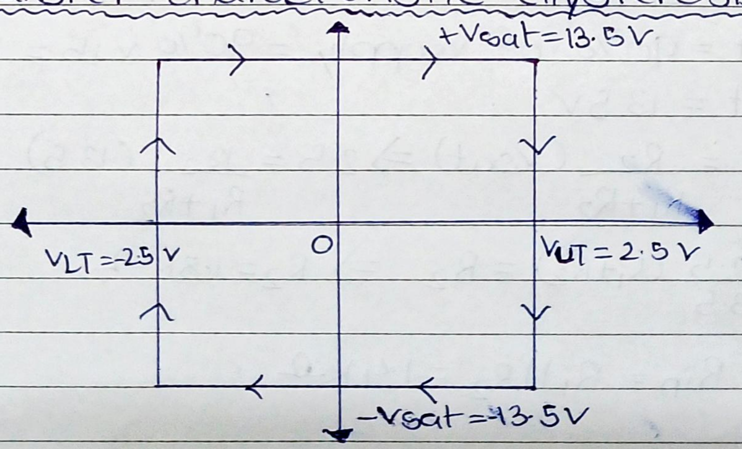
- Circuit Diagram



- Wave forms



- Transfer characteristic (Hysteresis)



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Date:
Page:

Q 2) Design a square wave and triangular wave and generator to operate at frequency of 1.5 KHz. $\beta = 0.5$ Given $R_1 = 10K$, $C = 0.1 \mu F$, $C_f = 0.01 \mu F$. Output has to be $V_{o(pp)} = 5V$. DC gain of integrator is 10. Draw neat circuit diagram indicating all components and wave forms

→ Given: $F_{sq} = 1.5 KHz$ $\quad R_1 = 10K$ $\quad A = 10$

$\beta = 0.5$ $\quad C = 0.1 \mu F$

$C_f = 0.01 \mu F$ $\quad V_{o(pp)} = 5V$

Soln:

$$T = \frac{1}{F_{sq}} = \frac{1}{1500 Hz} = 0.67 ms$$

$$T = 2RC \ln\left(\frac{1+\beta}{1-\beta}\right)$$

$$\frac{1}{1500} = 2R(0.1 \times 10^{-6}) \ln\left(\frac{1+0.5}{1-0.5}\right)$$

$$\therefore R = \frac{1}{3000(0.1 \times 10^{-6}) \ln\left(\frac{1.5}{0.5}\right)} = 3.0 k\Omega$$

$$\beta = \frac{R_1}{R_1 + R_2} \Rightarrow 0.5 = \frac{10k}{10K + R_2} \Rightarrow R_2 = 10K\Omega$$

$$\therefore R_1 = R_2 = 10K\Omega$$

Now, for integrator,

$$A = \frac{R_F}{R_3} \Rightarrow 10 R_3 = R_F$$

$$\therefore V_o = \frac{1}{R_3 C_F} \int_0^t v_{in}\, dt$$

for the first half cycle of square wave generator

i.e. $t=0$ to $t = \frac{1}{2(1500)} = \frac{1}{3000} = 0.34\,ms$

$$\therefore 2.5 = \frac{1}{-R_3(0.01\mu F)} \int_0^{0.34ms} -9\, dt$$

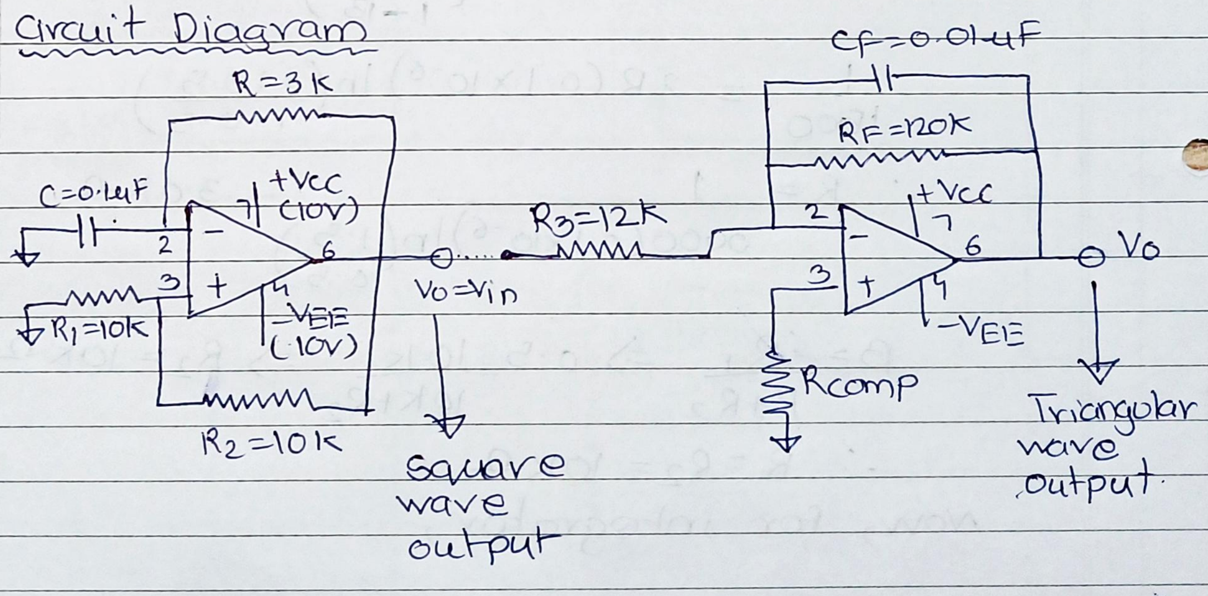
$$2.5 = \frac{1}{R_3(0.01 \times 10^{-6})} (9(0.34 \times 10^{-3}))$$

$$\therefore R_3 = \frac{9(0.34 \times 10^{-3})}{2.5(0.01 \times 10^{-6})} = 12k\Omega$$

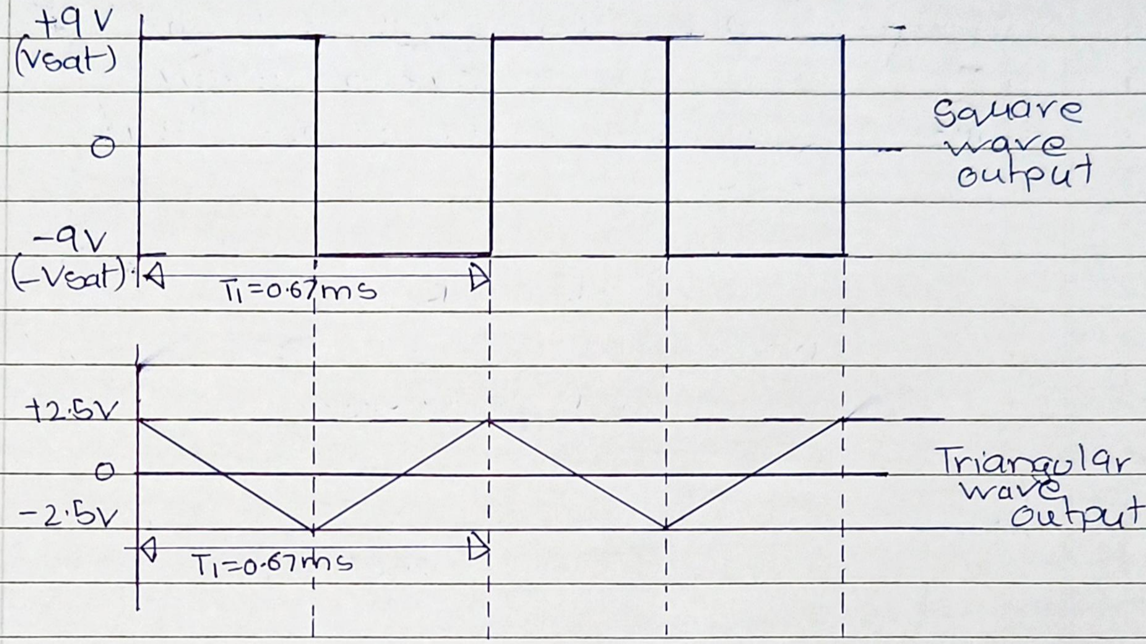
$$\therefore R_F = 10 R_3 = 120k\Omega$$

[$\because V_{in} = V_o$ of square wave.
$\therefore V_{in} = -9V$
assuming $V_{EE} = -10V$
$-V_{sat} = 90\%$ of V_{CC}]

- Circuit Diagram



- Wave forms


+9V
(Vsat)
0
-9V
(-Vsat)
T1=0.67ms
Square wave output
+2.5V
0
-2.5V
T1=0.67ms
Triangular wave output