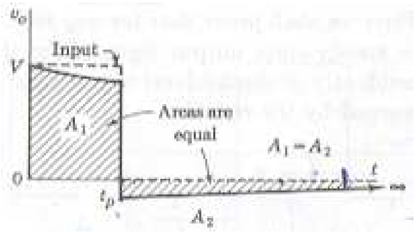
Statement: The area under the output waveform above the axis is equal to the area below the axis for pulse input to high pass RC circuit.

Proof:

Area under the output above the axis , A1 = $_0\int^{tp} Vo(t)\, dt$



A1 = $_0\int^{tp} Ve^{-tp/RC}\, dt$

A1 = VRC $(1-e^{-tp/RC})$

Area under the output below the axis , A2 = $_{tp}\int^{\infty} Vo(t)\, dt$

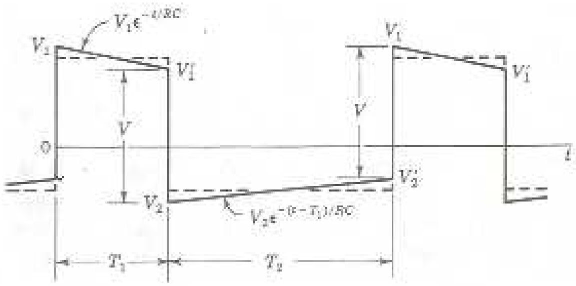
A2 = $_{tp}\int^{\infty} V(e^{-tp/RC} - 1)\, e^{-(t-tp)/RC}\, dt$

A2 = -VRC $(1-e^{-tp/RC})$

So A1 = A2

Hence proved.

Square wave input: steady state output waveform for square wave input is shown in figure.(operation of the circuit is same as pulse input)



Expressions for steady state voltages:

From the output waveform , $V_1' = V_1 e^{-T1/RC}$

$V_2' = V_2 e^{-T2/RC}$

$V_1 - V_2' = V$

$V_1' - V_2 = V$

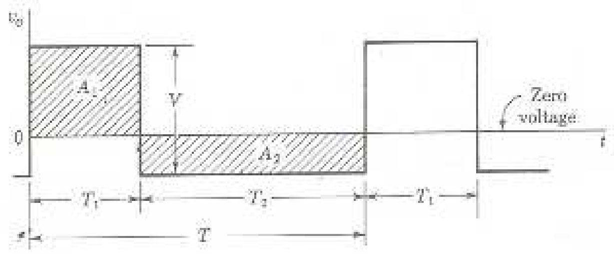
Statement: for any periodic input waveform to high pass RC circuit, the average level of the steady state output waveform is always zero irrespective of the input average level.

Proof:

By applying KVL to the loop,

$v_i(t) = 1/c \int i\, dt + Vo(t)$ and $i = Vo(t)/R$

$d\, v_i(t)/dt = Vo(t)/RC + d\, Vo(t)/dt$



integrating with respect to t between the limits 0 to T is

$v_i(T) - v_i(0) = \int_0^T (Vo(t)/RC)\, dt + Vo(T) - Vo(0)$

but we know for periodic waveform, $v_i(T) = v_i(0)$

$Vo(T) = Vo(0)$ so $\int_0^T (Vo(t)/RC)\, dt = 0$

$\int_0^T Vo(t)\, dt = 0$

Hence proved.

Symmetrical square wave input :

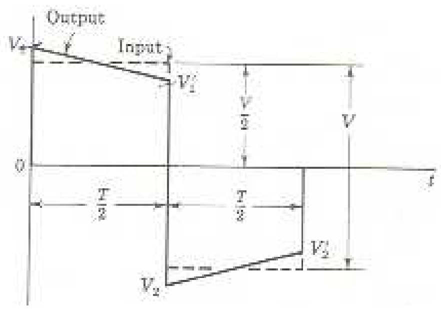
For symmetrical square wave input T1=T2 so

$V_1' = V_1 e^{-T/2RC}$

$V_2' = V_2 e^{-T/2RC}$

And also $V_1 = - V_2$

$V_1' = - V_2'$ (since from the above statement)



Percentage tilt of the output waveform:

Percentage tilt is defined by $p = \{V_1 - V_1' /(V/2)\} X\ 100$

We know $V_1' - V_2 = V$

$V_1' + V_1 = V$

$V_1 e^{-T/2RC} + V_1 = V$

$V_1 = V/1 + e^{-T/2RC}$ --------(1)

$V_1' = V_1 e^{-T/2RC}$

$V_1' = e^{-T/2RC} V/1 + e^{-T/2RC}$ -------(2)

So $p = [(1 - e^{-T/2RC})/(1 + e^{-T/2RC})] X 200$

(by using equations 1and 2)

If $T/2RC \ll 1$ then $p = [T/2RC] X 100$

$p = [1/2fRC] X 100$

$p = [\pi f_1/f] X 100$

where f1 is the lower cutoff frequecncy of high pass RC circuit.