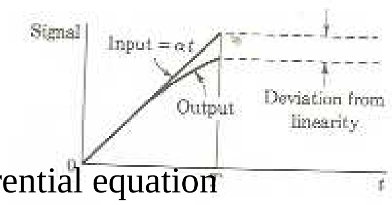
Ramp input:



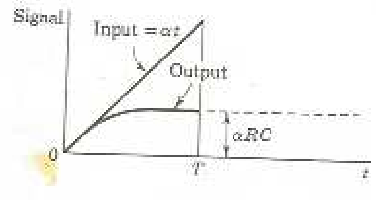
We know for an high pass RC circuit,

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

but here $vi(t) = \alpha t$

$\alpha = Vo(t)/RC + d\,Vo(t)/dt$ it is a first order differential equation

by solving this equation ,



$Vo(t) = \alpha RC\,(1- e^{-t/RC})$

If RC<<Ts , then $Vo(t) = \alpha RC$

If RC>>Ts , then $Vo(t) = \alpha t[1-(t/2RC)]$

High pass RC circuit as a differentiator:

For high pass RC circuit,

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

if RC is low then voltage across the capacitor is maximum and output voltage is almost zero . so $v_i(t)= 1/c \int i\,dt$

So $i = c\,d\,v_i(t)/dt$

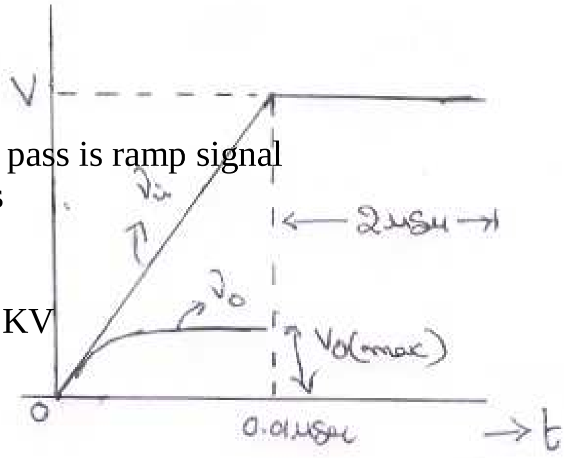
$Vo(t) = RC\,d\,v_i(t)/dt$ since $Vo(t) = iR$

Hence high pass RC acts as a differetiator when RC <<T

It produces spikes by taking square wave input.

Problems on high pass RC circuit:

1. the pulse from a high voltage generator raises linearly for 0.01μsec and then remains constant for 2μsec. The rate of rise of the pulse is measured with an RC differentiating circuit whose time constant is 200 pico secs.if the positive output voltage from the differentiator as a maximum value of 60 V .determine peak value of the generator.



Solution:

From the given data input waveform to high pass is ramp signal

So $Vo(t)= \alpha RC\,(1- e^{-t/RC})$ but here RC<<Ts

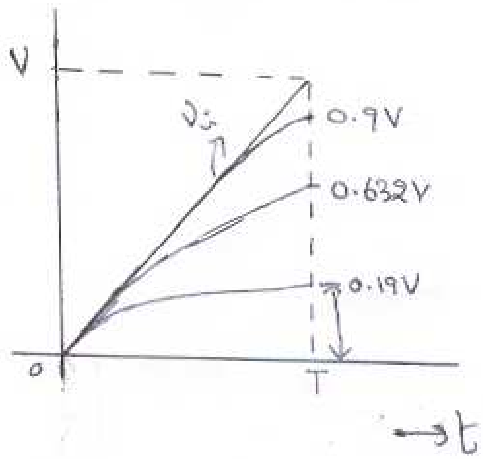
So $Vo(t) = \alpha RC$

Then $\alpha = Vo(max)/RC = 3 \times 10^{11}$

Hence peakvalueof the generator $Vi = \alpha\,Ts = 3$ KV

2. A limited ramp of V volts is applied to an RC differentiator circuit .what is the peak value of the output waveform for (a) T = RC (b) T =0.2 RC (c) T =5 RC .

Solution;



Here Vo(t)= $\alpha RC\,(1- e^{-t/RC})$ and $\alpha = V/T$

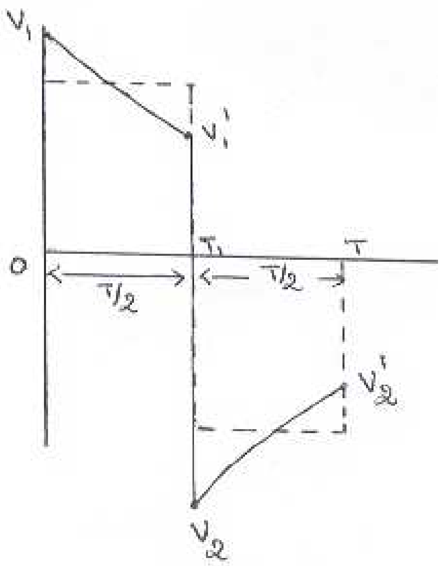
Peak value of output is Vo(T)= $VRC\,(1- e^{-T/RC})/T$

(a) if T =RC then Vo(T) = 0.632V volts
(b) if T =0.2RC then Vo(T) = 0.9063V volts
(c) if T =5RC then Vo(T) = 0.1986V volts

2. a 10 Hz symmetrical square wave is applied to an RC circuit .calculate and plot the output waveform under the following conditions. The lower3-dBfrequency is
   (a) 0.3 Hz (b) 3 Hz (c) 30 Hz

Solution:

For symmetrical square wave input to high pass RC ,



$V_1 = - V_2$

$V_1' = - V_2'$

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

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

From the given data T = 0.1sec

We know

f1 = 1/2π RC so RC = 1/2 π f1

(a) f1 = 0.3Hz then RC =0.5305 sec

so $V_1 = V / 1 + e^{-T/2RC}$ = 0.523 V volts

and V_1' = 0.476 V volts

(b) f1 = 3Hz then RC =0.05305 sec
so $V_1 = V/1+e^{-T/2RC}$ = 0.7197 V volts
and V_1' = 0.328 V volts

(c) f1 = 30Hz then RC =5.305m sec
so $V_1 = V/1+e^{-T/2RC}$ = 0.99 V volts
and V_1' = 0.432 V volts