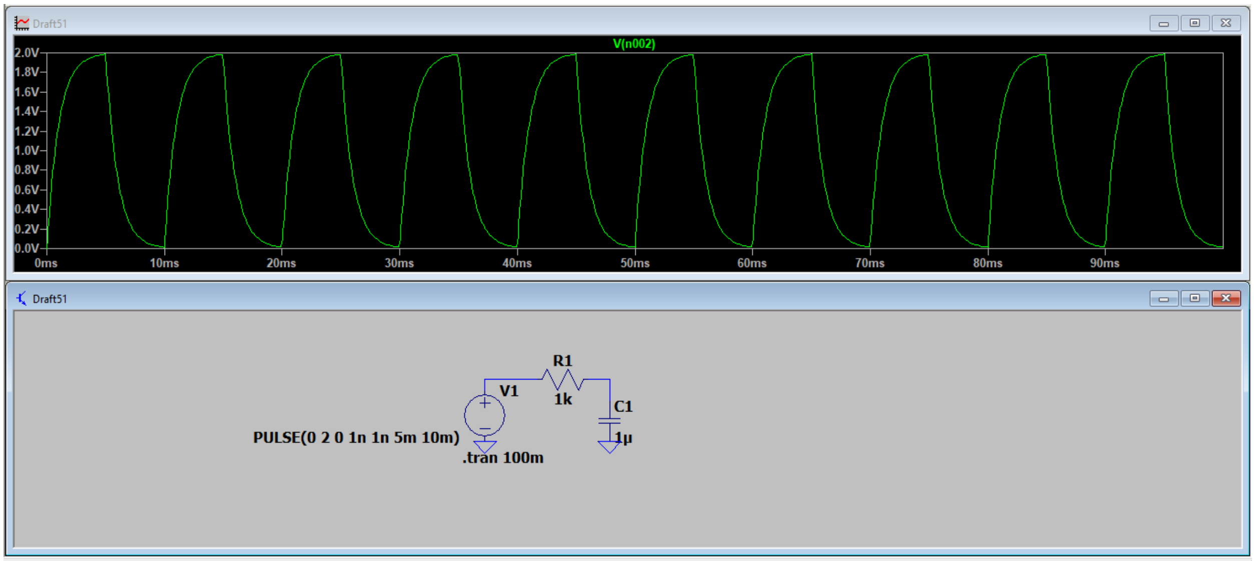
FOURIER SERIES & RC ckt?

We all know about fourier series and transform plays very vital role in removing noise, image processing signal processing etc. But what is it significance?

Let's consider an example of LPF RC circuit to figure it out:

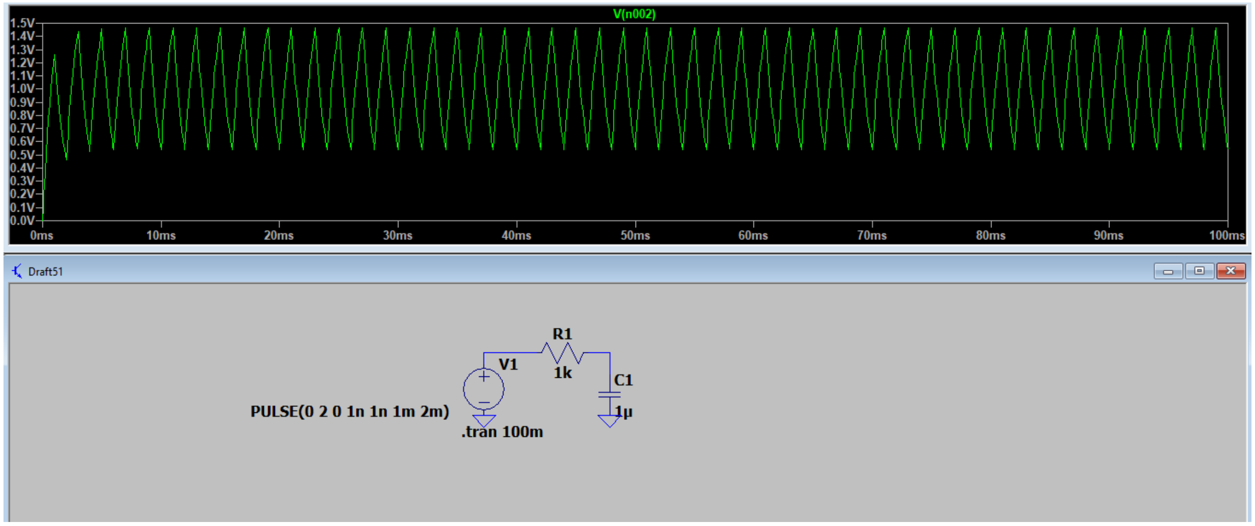


In this case, R=1kohm C=1uf so cutoff frequency of RC LPF is 1/RC=>1KHz

We applied a pulse of frequency =1/10m=100Hz.

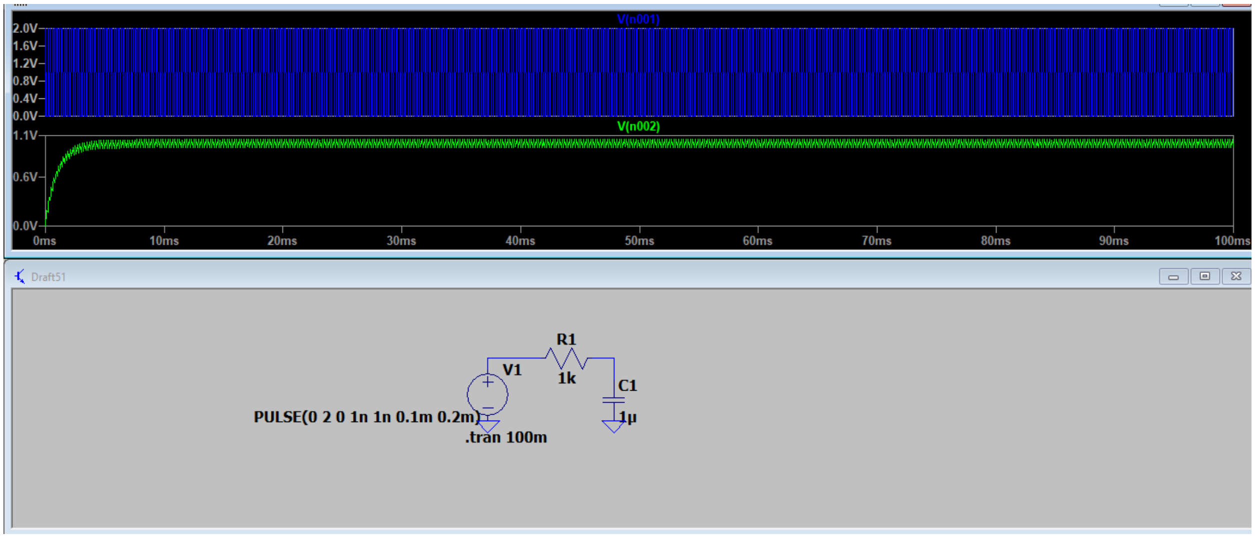
So, if this frequency is less than the cutoff frequency can be executed by the system. Also, in this case there is enough time for charging and discharging.

Now, what happens if we increase the frequency of input pulse i.e. decreasing time period.



Here due to incomplete charging and discharging couldn't take place fully, after some sort of time it attains steady state.

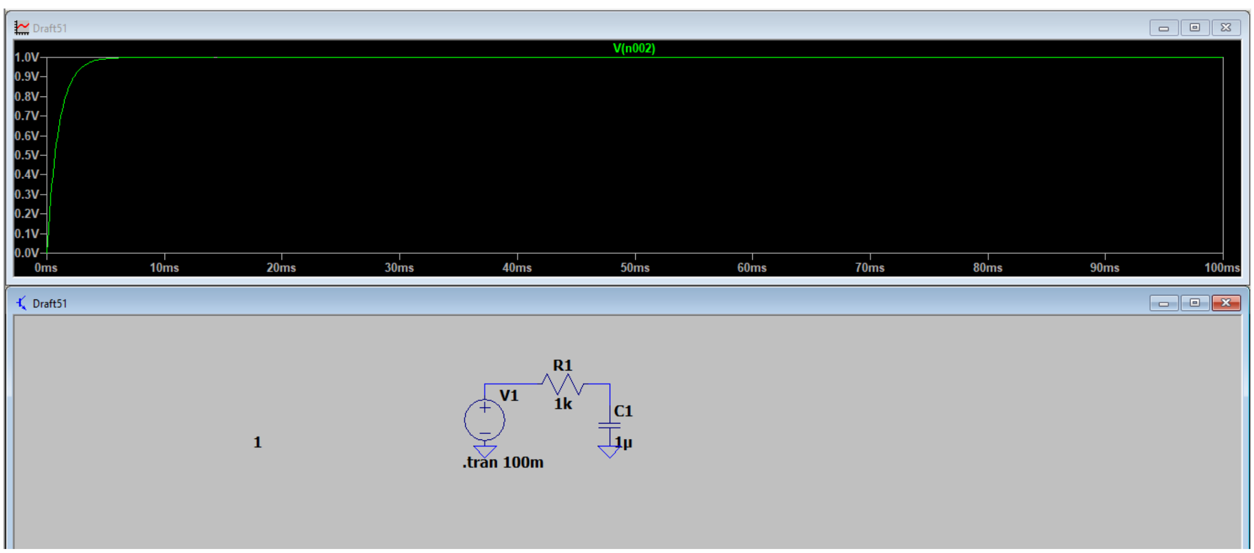
What if frequency goes beyond a certain level



Now the frequency of the pulse (blue curve) is 10Khz

And the response of the circuit is given in green curve.

Isn't it a response somewhat(if we just avoid that spikes) same as that of transient response RC circuit applied by voltage source = 1V.



So, the question arises how can a non-dc input (pulse) can behave same as a constant dc source. Well, here the fourier series comes into the picture. As discussed earlier the given circuit is an LPF RC circuit with cutoff frequency 1Khz.

$F(x)=A0 + (4/\pi)* \Sigma((1/n)*\sin(n\pi x/L))$ ____________________(1)

Where A0 is the dc component=(max value + min value)/2

In our case it is A0=1V.

Now, it is easy to figure out when frequency of the input pulse is very high compared to the cutoff frequency of the RC circuit. It is not able to catch up with higher harmonics, so, the sinusoidal portion in equ 1 is rejected and only the dc component left which is now acting as source.

This is why the RC circuit with non-dc signal as input is responding as if it operated in dc !.