

Ex: No:2

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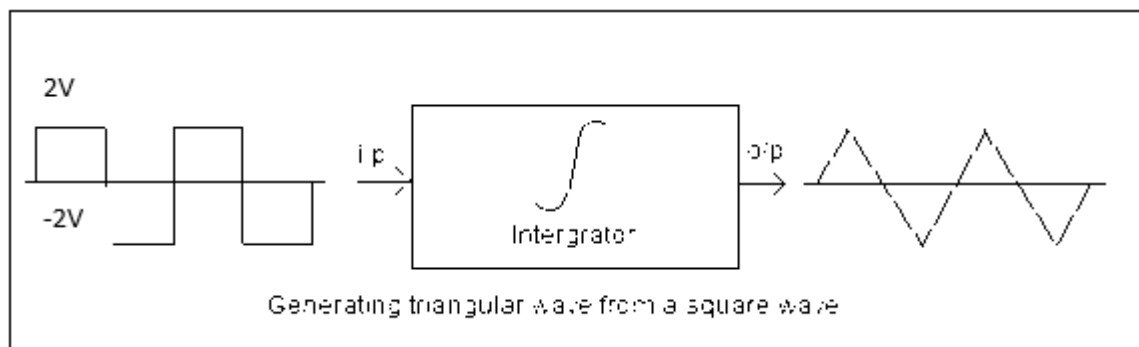
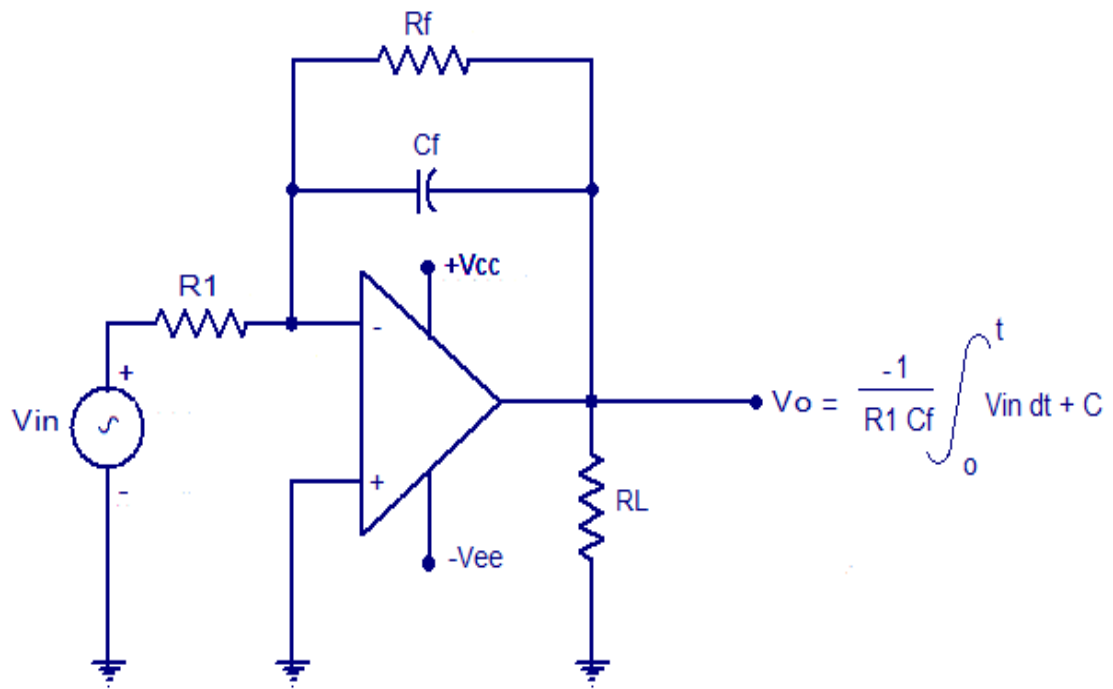
Aim: **Design of integrator and differentiator using op-amp**

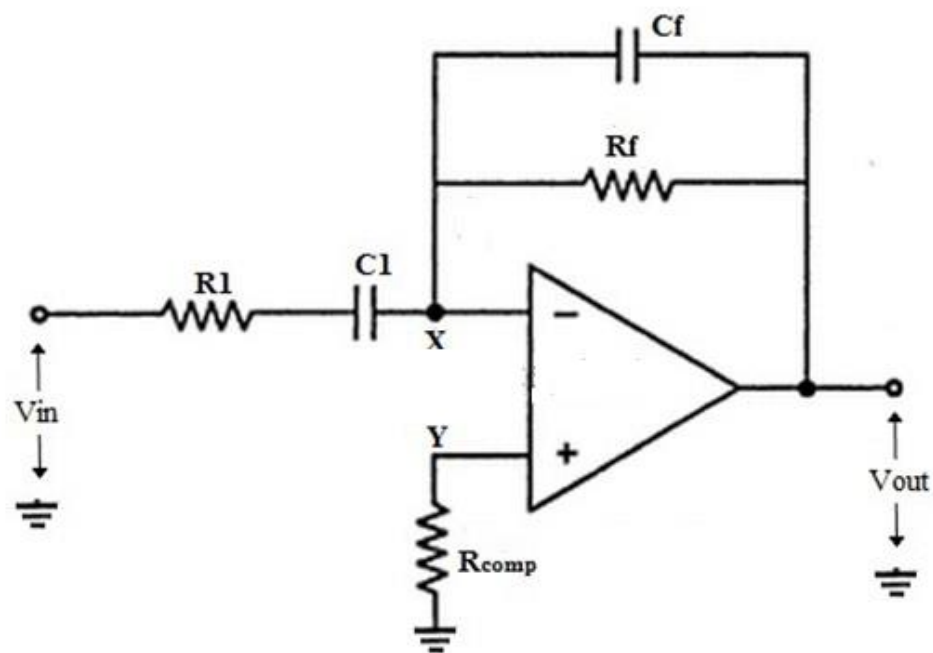
Apparatus required:

Name	Specialization	Quantity
Resistor	1)100k 2)10k 3)1.6k 4)75.7 5)79.5 6)9.09k	One each of them
capacitor	1)16nF 2)5nF 3)0.1mF	One each of them
Op-amp	LM-741	2
V-pulse	V1=1 V2=-1 TD=0 TR=1n TF=1n PW=0.5m PER=1m	2
V-DC	15V	4

Circuit diagram/ Calculation/equation:

Practical op-amp integrator





A Practical Op-amp Differentiator Circuit

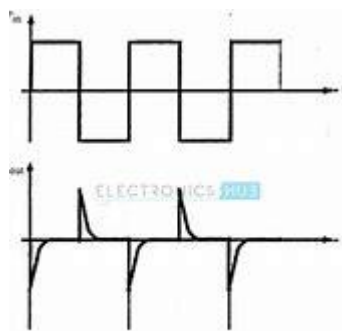


Fig. Input and Output waveforms for Square wave

$$v_0 = -R_F C_1 \frac{dv_{in}}{dt}$$

Integrator

$$f_b = \frac{1}{2\pi R_1 C_F} \quad ; \quad \frac{R_F}{R_1} = 10$$

Assume $f_b = 1$; $\Rightarrow C_F = \frac{1}{2\pi \times 10^3 \times 1}$

$R_1 = 10k\Omega$
 $R_F = 100k\Omega$

$$C_F = 16nF$$

$f = 1kHz$; $T = \frac{1}{f} = 1ms$ $R_{com} R_1 \parallel R_F$

$$= \frac{10 \times 100k\Omega}{110}$$

$$= 9.09k\Omega$$

Differentiator

$$f_a = \frac{1}{2\pi C_1 R_F} = 1kHz$$

$C_1 \leq 1\mu F$, Assume $C_1 = 0.1\mu F$

$$\Rightarrow R_F = \frac{1}{10^3 \times 2\pi \times 0.1 \times 10^{-6}} = 1.6k\Omega$$

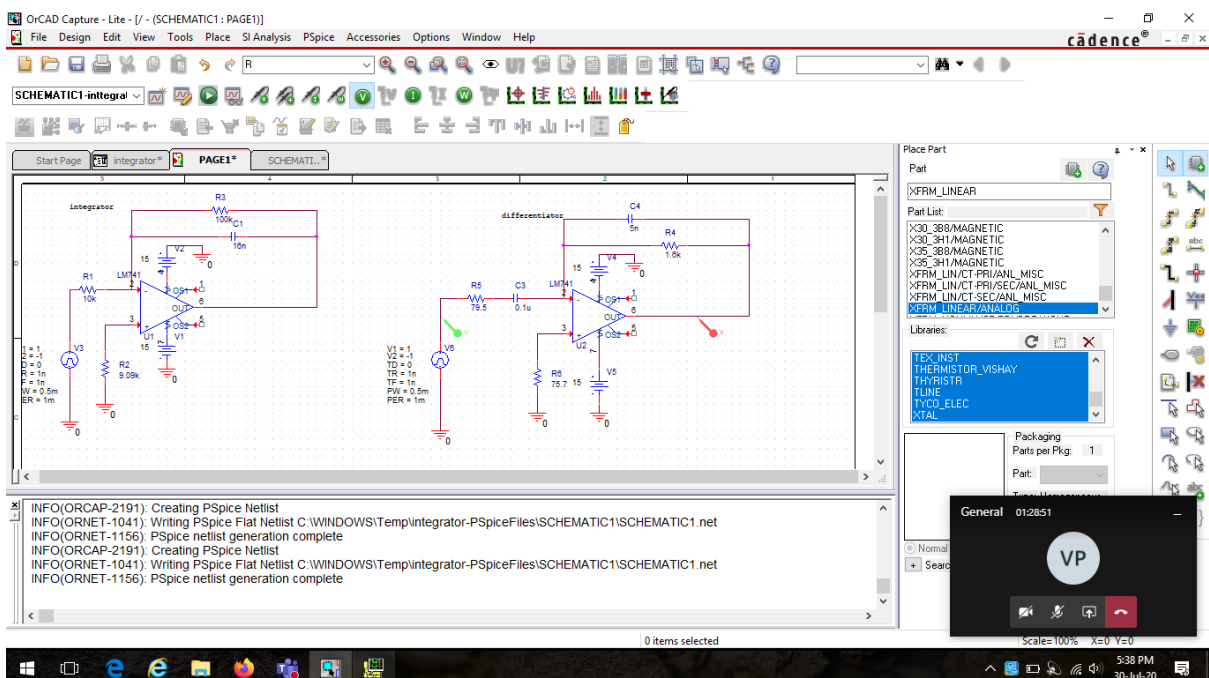
$f_b = 20f_a = 20kHz$

$$f_b = \frac{1}{2\pi R_1 C_1} \Rightarrow R_1 = \frac{1}{20 \times 10^3 \times 2\pi \times 0.1 \times 10^{-6}} = 79.5\Omega$$

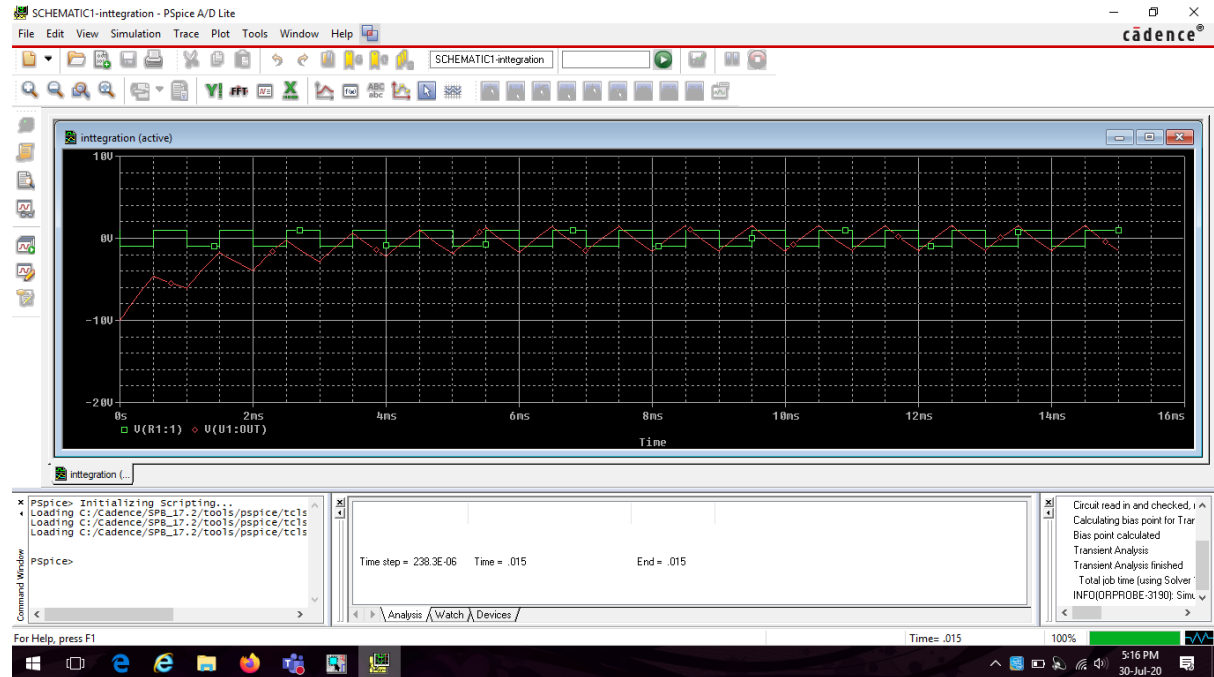
$R_1 C_1 = R_F C_F \Rightarrow C_F = \frac{79.5 \times 0.1 \times 10^{-6}}{1.6 \times 10^3} = 5nF$

Simulation diagram:

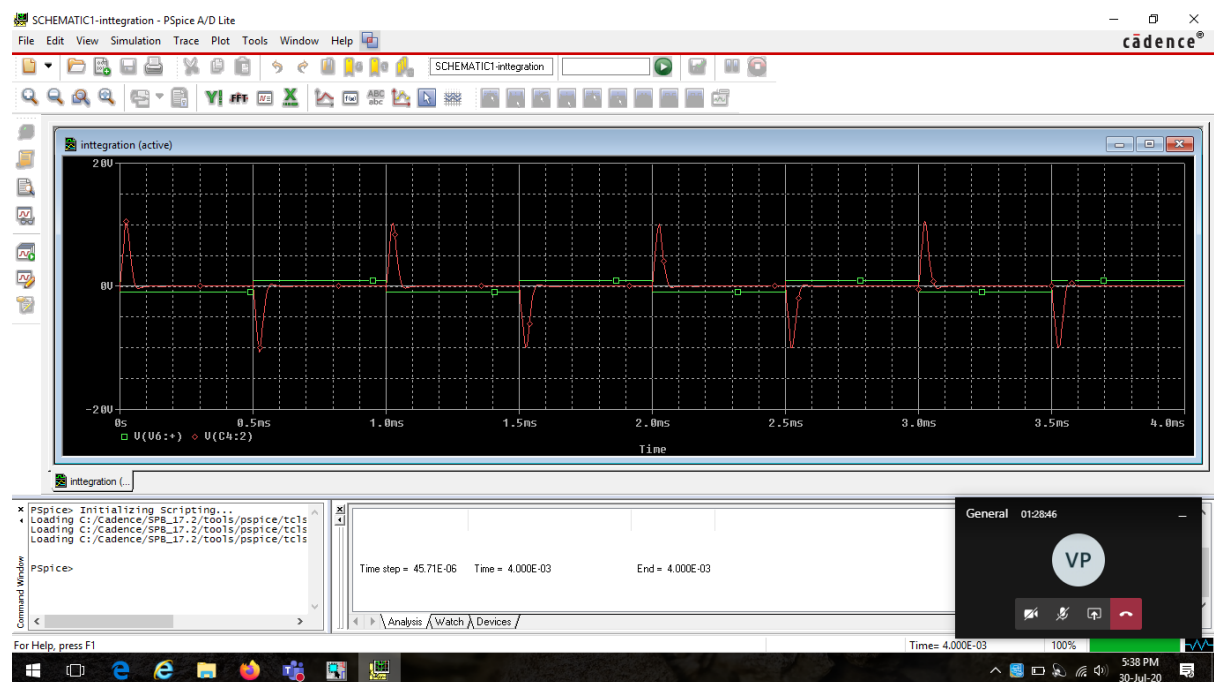
Output graph:



INTEGRATOR:-



DIFFERENTIATOR:-



Result and inference: The integrator changes square wave to triangular wave while a differentiator gives a spike waveform.