Lab Session 14

Integrator and differentiator using operational amplifier

Objective:

To design and test the performance of integrator and differentiator circuits using Op-amp.

Theory:

Integrator: In an integrator circuit, the output voltage is integral of the input signal. The output voltage of an integrator is given by

$$V_o = -1/R_1C_f \int_o^t Vidt$$

At low frequencies the gain becomes infinite, so the capacitor is fully charged and behaves like an open circuit. The gain of an integrator at low frequency can be limited by connecting a resistor in shunt with capacitor.

Differentiator: In the differentiator circuit the output voltage is the differentiation of the input voltage. The output voltage of a differentiator is given by

$$V_o = -RfC_1 \frac{dV_i}{dt}$$

The input impedance of this circuit decreases with increase in frequency, thereby making the circuit sensitive to high frequency noise. At high frequencies circuit may become unstable.

DESIGN:

INTEGRATOR:

Given :

R1= 10 K ; f= 4 kHz

Cf = 1/ (2πRf)

Rf = 10 R

= 10 * 10 K = 100 K

Cf = 1/ (2π * 103*10*4*103)

= 0.039 μf

DIFFERENTIATOR:

Given:

C1 = 1 μf ; f1 = 150 kHz

Rf = 1/ (2πC1f1)

= 1/ (2*3.14*1*10-6*150)

Rf = 1.06 K

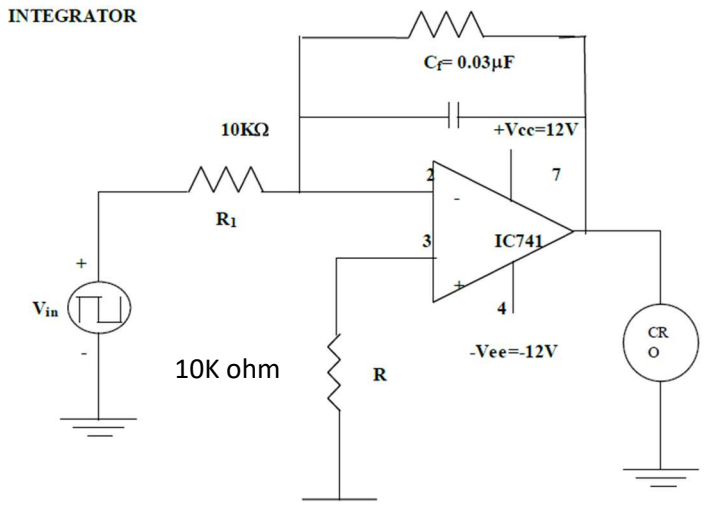
Cf = R1C1/Rf

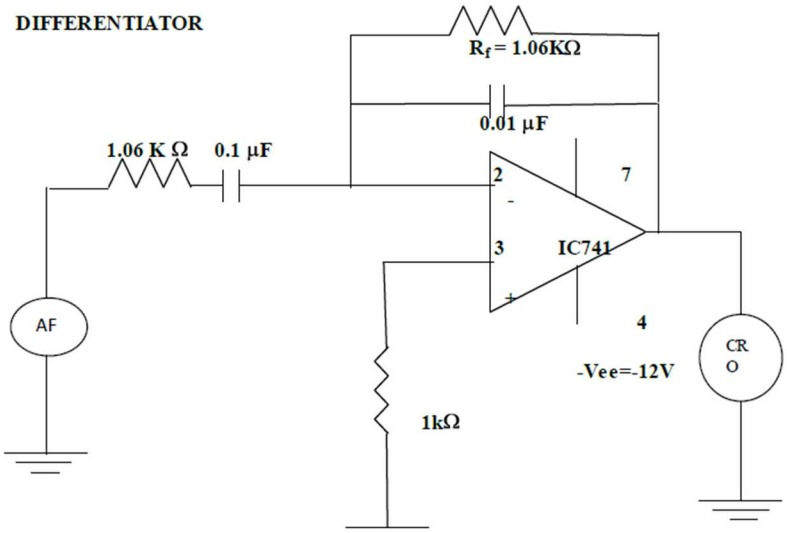
= 1.06*10-3*0.1*10-6

10.6 * 103

Cf = 0.01 µf

Rf = 100K





Equipments used:

- Signal generator
- CRO
- Resistors
- Capacitor
- Op-amp
- Breadboard
- Dual power supply
- Connecting wires

Procedure:

Integrator:

1. Connections are made as per the circuit diagram.
2. Apply the square or sine input signal at high frequency using AFO.
3. Note the corresponding output waveforms and plot the graph.

Differentiator:

1. Connections are made as per the circuit diagram.
2. Apply the square or sine input signal at low frequency using AFO.
3. Note the corresponding output waveforms and plot the graph.

Table:

INTEGRATOR:

PARAMETER	THEORITICAL	PRACTICAL
1. Frequency 2. I/P time period 3. O/P time period 4. I/P Amplitude 5. O/P Amplitude		

Table 14.1

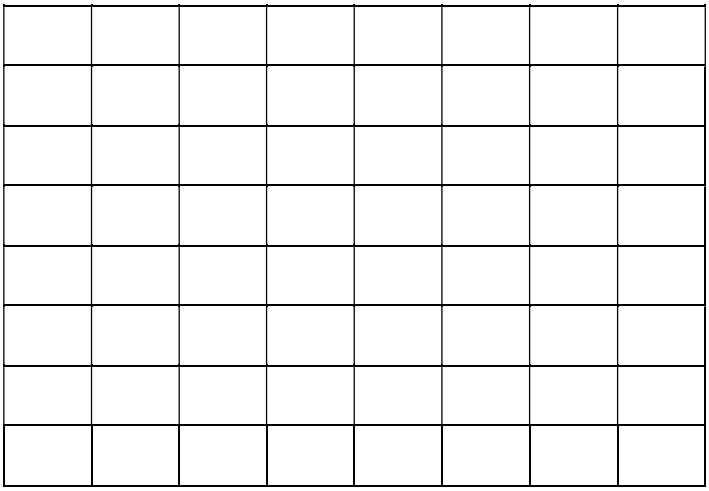
DIFFERENIATOR:

PARAMETER	THEORITICAL	PRACTICAL
1. Frequency 2. I/P time period 3. O/P time period 4. I/P Amplitude 5. O/P Amplitude		

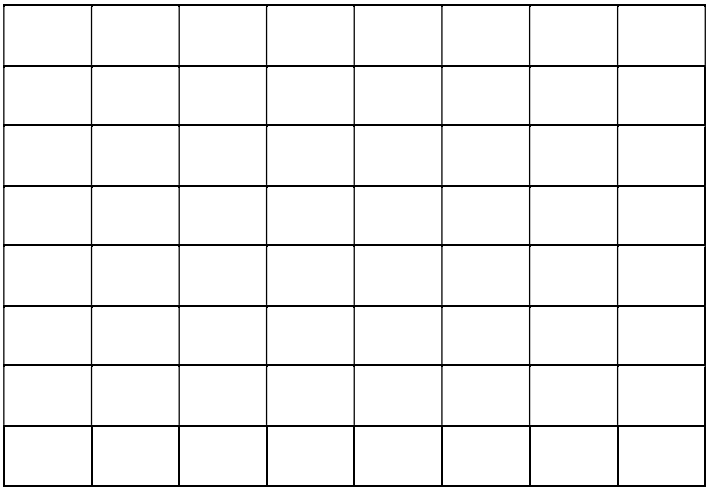
Table 14.2

Graphs

Integrator



Differentiator



Conclusions & Comments: