6/19/2022

EXPERIMENT NO.8

EC111

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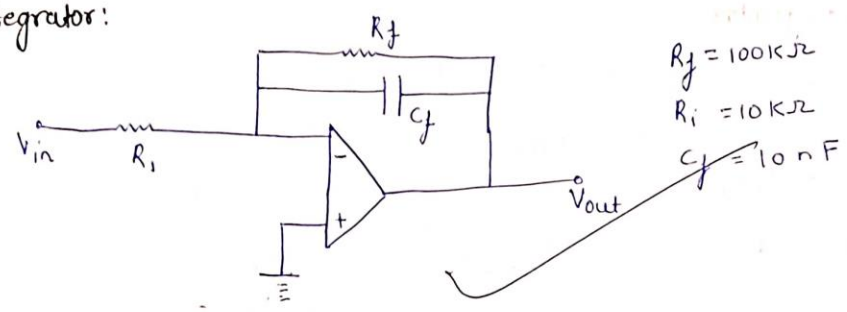
Roll: 2101227

Experiment No. 8

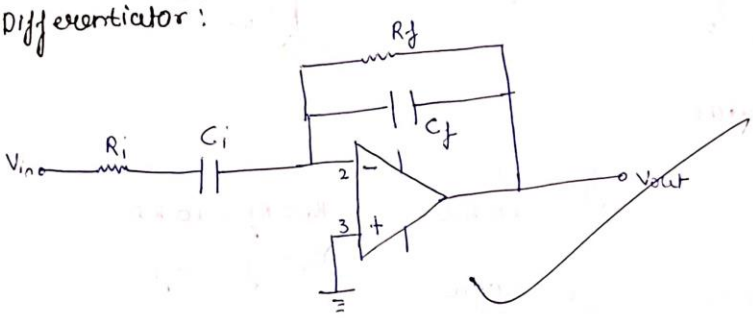
Aim:
1) Design a differentiator and differentiate a triangular signal that varies in frequency 10Hz to 1kHz
2) Design an integrator and integrate a square wave signal that varies in frequency from 10Hz to 1kHz.

Circuit Diagram:

integrator:

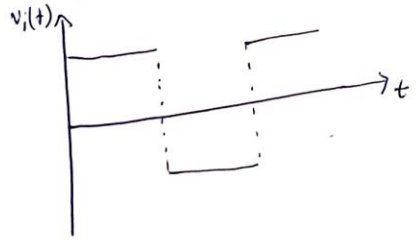


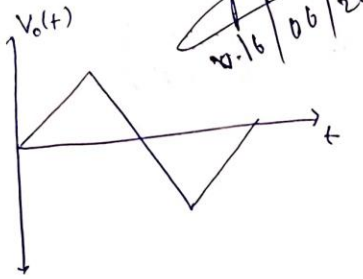
Differentiator:



Graphs:

integrator:





Verified
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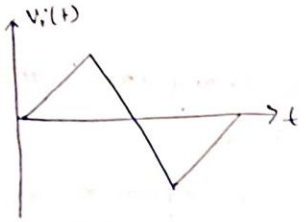
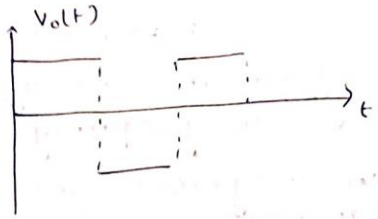
Differentiator:





Calculation:

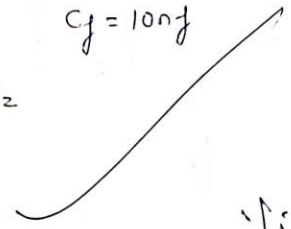
For Integrator:

$R_1 = 10K\Omega$ $\quad R_f = 100K\Omega$ $\quad C_f = 10nf$

$$f_a = \frac{1}{2\pi R_f C_f} = 159.09\ Hz$$

$$f_b = 10 f_a = 1590.9\ Hz$$

$$V_o = -\frac{1}{R_1 C_f}\int_0^t V_{in}(t) + V_o(0)$$



verified
16/06/2022

For differentiator:

$$f_a = \frac{1}{2\pi R_f C_1} \qquad f_b = \frac{1}{2\pi R_1 C_1}$$

$R_1 = R_f = 10\ K\Omega$

$C_1 = C_f = 10nf$

$f_a = 159.09\ Hz$ $\qquad f_b = 20 f_a$

$$R_1 C_1 = R_f C_f$$

$$V_o = -R_f C_1 \left(\frac{dV_i}{dt}\right)$$

EXPERIMENT NO. 8

TITLE: IMPLEMENTATION OF DIFFERENTIATOR AND INTEGRATOR CIRCUITS.

OBJECTIVE:

- To design an integrator using OP-Amp and integrate a square wave signal that varies in frequency from 10 Hz to 1KHz.
- To design a differentiator using OP-Amp and differentiate a triangular wave signal that varies in frequency from 10 Hz to 1KHz.

APPARATUS REQUIRED:

- Breadboard
- Connecting wires
- Resister
- Power supply
- 741 IC (op-amp)

THOREY:

INTEGRATOR:

It is a circuit designed with Op-Amp in such a way that it performs the mathematical Integration operation, its output is proportional to the amplitude and time duration of the input applied. The integrator circuit layout is the same as an inverting amplifier but the feedback resistor is replaced by a capacitor which makes the circuit frequency-dependent. In this case, the circuit is derived by the time duration of input applied which results in the charging and discharging of the capacitor. Initially, when the voltage is applied to the integrator the uncharged capacitor allows maximum current to pass through it and no current flows through the Op-Amp due to the presence of virtual ground, the capacitor starts to charge at the rate of the RC time constant and its impedance starts to increase with time and a potential difference is develops across the capacitor resulting in charging current to decrease. This results in the ratio of capacitor's impedance and input resistance increasing causing a linearly increasing ramp output voltage that continues to increase until the capacitor becomes fully charged.

DIFFERENTIATOR:

In the differentiator circuit, the input is connected to the inverting output of the Op-Amp through a capacitor(C) and negative feedback is provided to the inverting input terminal through a resistor (Rf), which is the same as an integrator circuit with feedback capacitor and input resistor being replaced with each other. Here the circuit performs a mathematical differentiation operation, and the output is the first derivative of the input signal, 180' out of phase and amplified with a factor Rf*C. The capacitor on the input allows only the AC component and restricts the DC, at low frequency the reactance of the capacitor is very high causing a low gain and high-frequency vice versa but and high frequency the circuit becomes unstable.

CIRCUIT DIAGRAM:

INTEGRATOR:

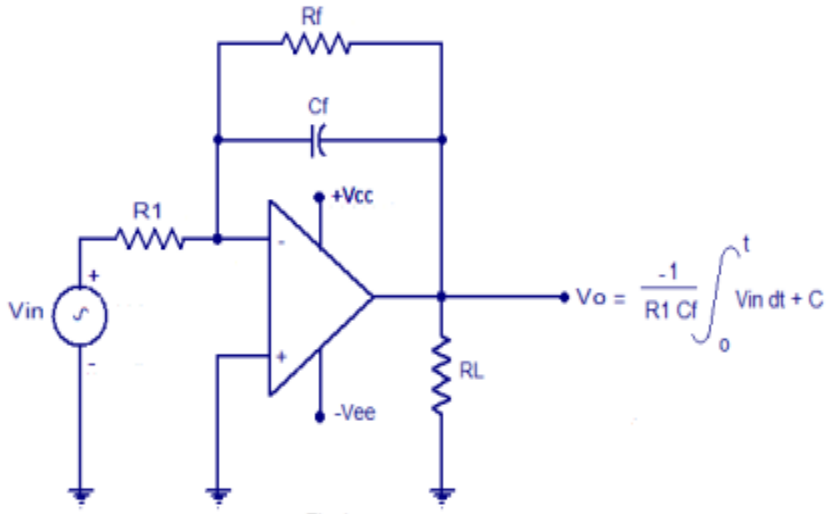
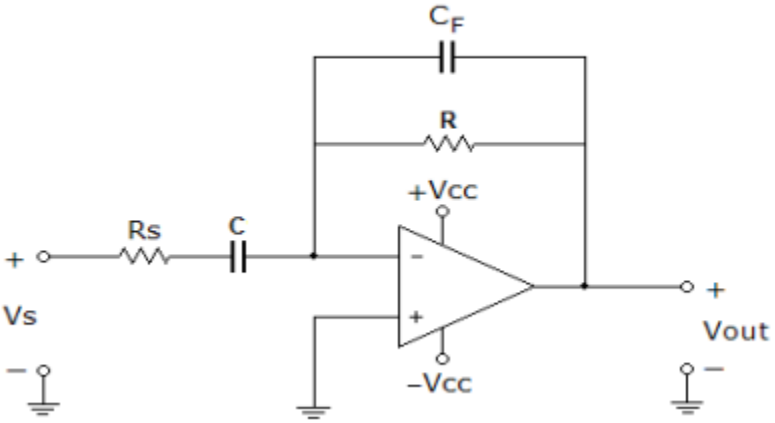


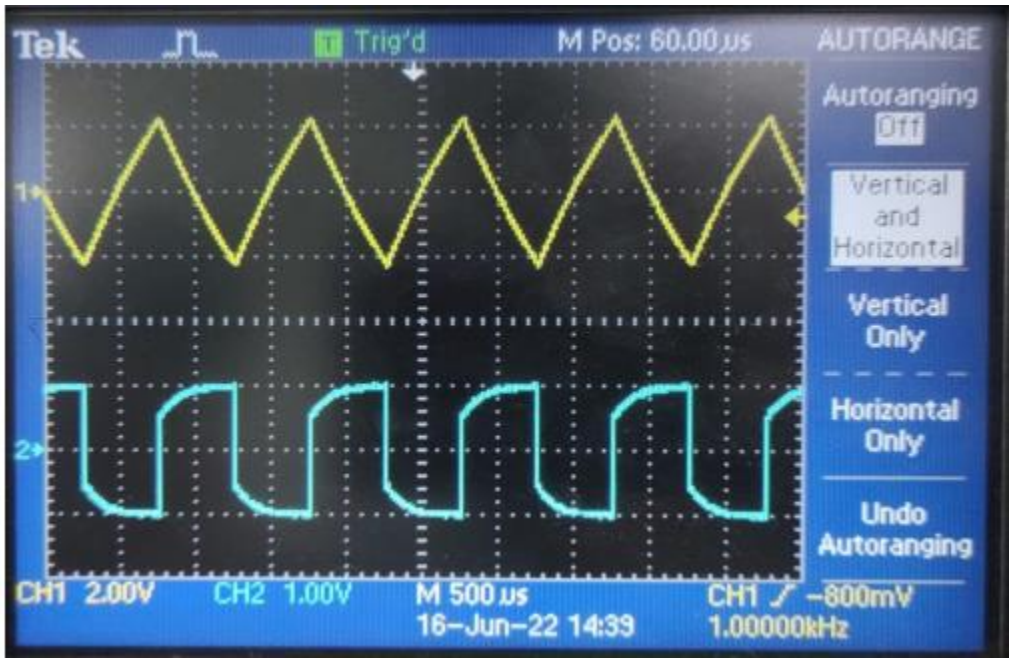
Fig 4

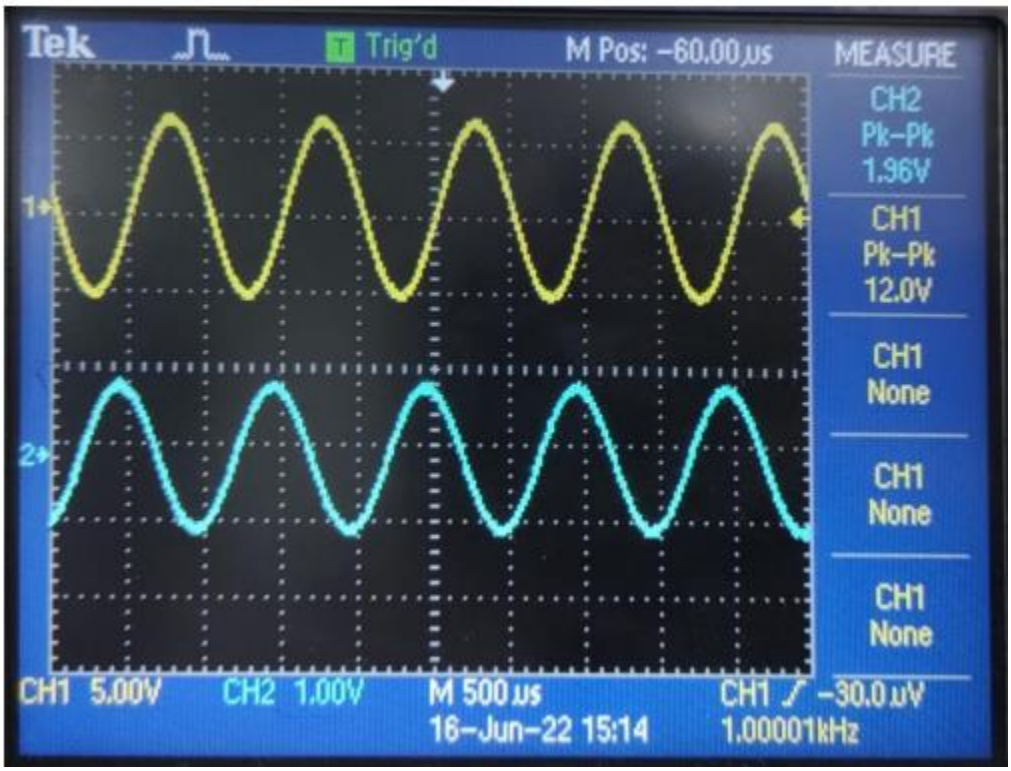
DIFFERENTIATOR:



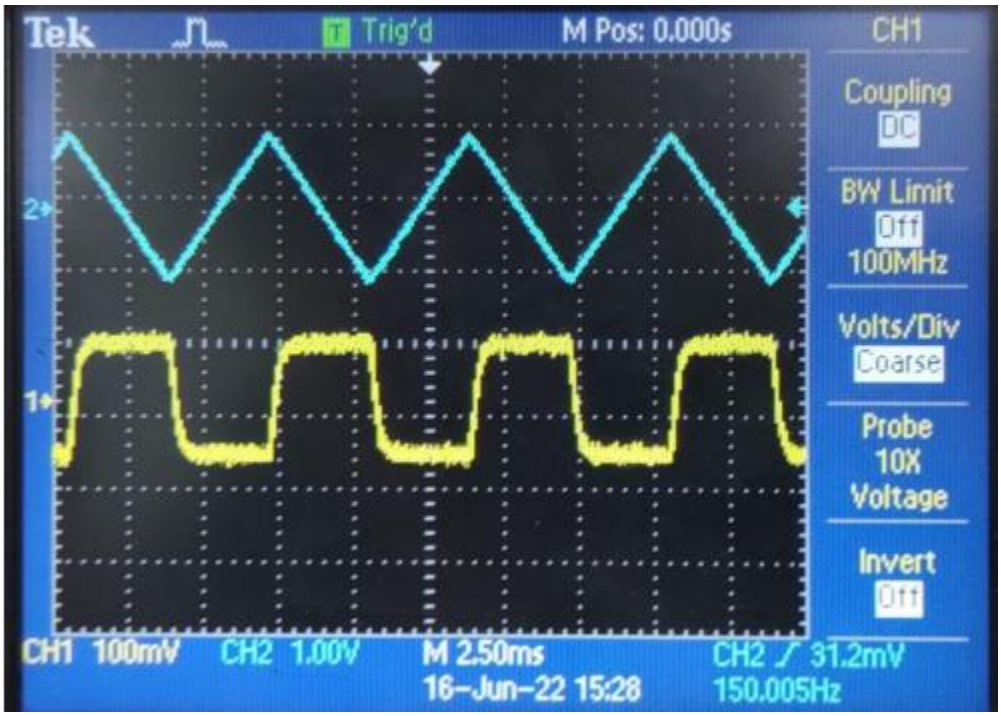
OBSERVATION:

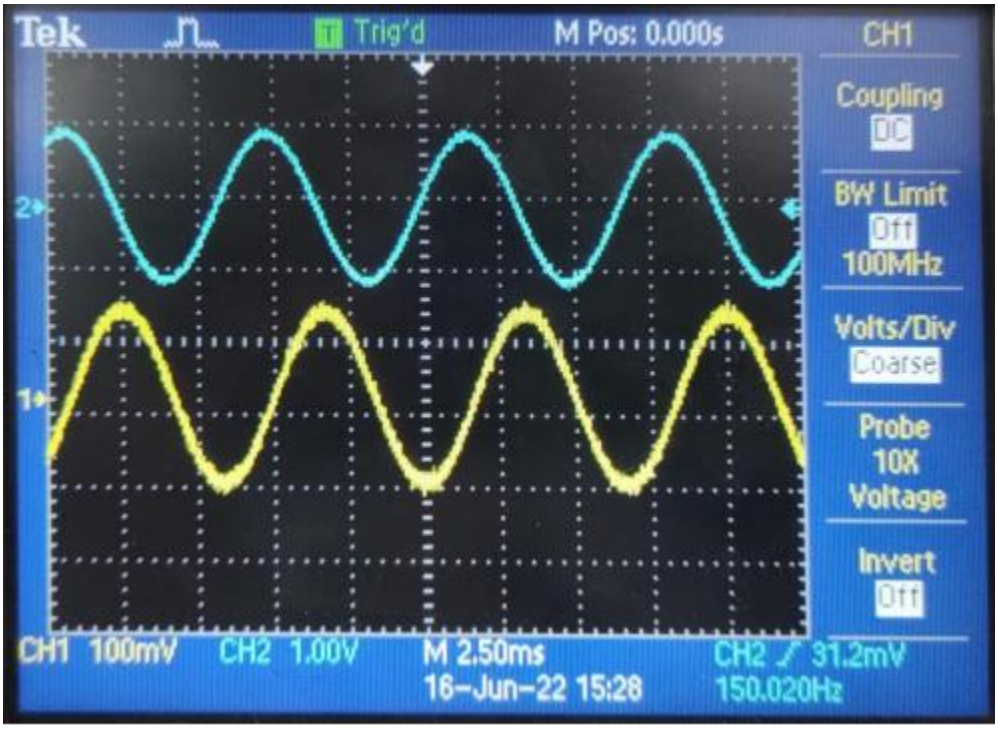
INTEGRATOR:





DIFFERENTIATOR:





RESULT:

- Successfully verified the integrator using Op-Amp.
- Successfully verified the differentiator using Op-Amp.

PRECAUTIONS:

- Connections should be made accordingly to the circuit diagram only.
- Do not be on the DC power supply for a long time otherwise diode may be burned.
- Wires should be tight and no short-circuiting should be there.
- Do not cross the maximum power rating.