Exp.No.6

DIFFERENTIATOR

AIM:

To design and verify the operation of a differentiator circuit using op amp 741 IC.

APPARATUS:

1. Operational Amplifier mA 741 IC –1No.
2. Resistors 1KOhm and 10KOhm
3. Capacitor 0.1µf
4. Dual Power supply(0-20V)
5. Regulated Power Supply.(0-20V)
6. Multimeter
7. CRO and Probes
8. Funtion Signal Generator.
9. Bread board
10. Connecting wires

THEORY:

Differentiator performs the reverse of integration function. Differentiator circuits as its name implies, performs the mathematical operation of differentiator, that is, the output waveform is the derivative of the input. The differentiator may be constructed from a basic inverting amplifier when an input resistor R1 is replaced by a capacitor C, An ideal differentiation is shown in below figure.

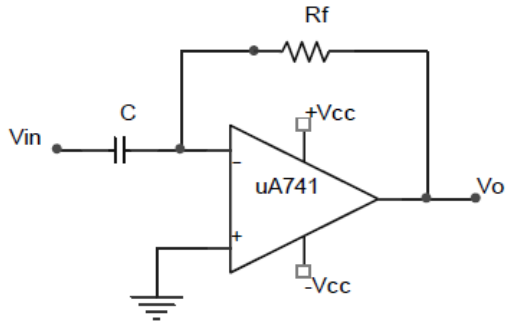


Figure: Basic Op-Amp Differentiator

The output voltage is given by

$$V_{out} = -RC \frac{dv_{in}}{dt}$$

Thus, the output Vo is equal to the $R_f C$ times the negative instantaneous rate of change of the input voltage Vin with time.. A linear, positive rate of input voltage change will result in a steady negative voltage at the output of the op-amp. Conversely, a linear, negative rate of input voltage change will result in a steady positive voltage at the output of the op-amp. This polarity inversion from input to output is due to the fact that the input signal is being sent (essentially) to the inverting input of the op-amp, so it acts like the inverting amplifier

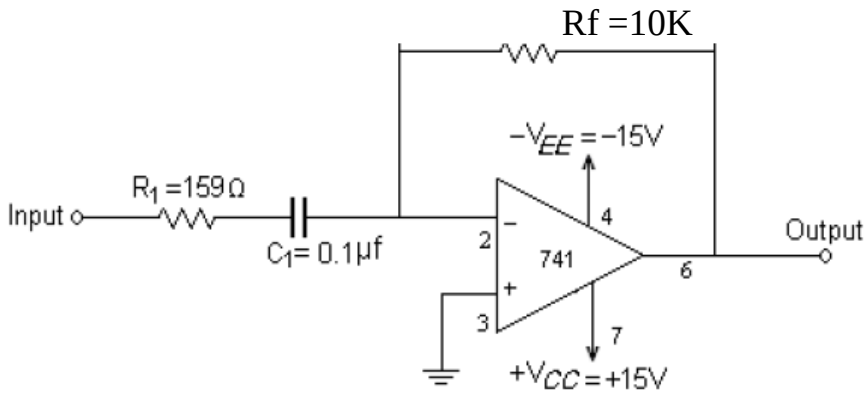
Since the differentiator performs the reverse of the integrators function, triangular wave input will produce a Square wave output ,or a cosine wave input will produce a sine wave output. If we apply square wave as input signal output is a spike wave .

The input signal will be differentiated properly if the time period T of the input signal is larger than or equal to $R_f C1$. That is, $T \geq R_f C1$

Differentiator has wide applications in

1. Monostable Multivibrator
2. Signal wave shaping
3. Function Generators.

CIRCUIT DIAGRAM:



PROCEDURE:

1.Initially set +Vcc = 12 volts and -Vcc to -12 volts.

2.Measure all resistors that are used in the amplifier circuits using the multimeter and record these values

3. As shown in the circuit diagram connect the circuit for differentiator on a breadboard

4.Before turning any power on, double check the wiring to make sure that it is correct. Make sure that the power supply to the op-amp is correctly wired as not to apply the incorrect polarity to the op-amp.

5. Apply sine wave at the input terminals of the circuit using function Generator.

6. Connect channel-1 of CRO at the input terminals and channel-2 at the output terminals.

7. Observe the output of the circuit on the CRO which is a cosine wave (90^o phase shifted from the sine wave input) and note down the position, the amplitude and the time period of Vin & Vo.

8. Now apply the square wave as input signal.

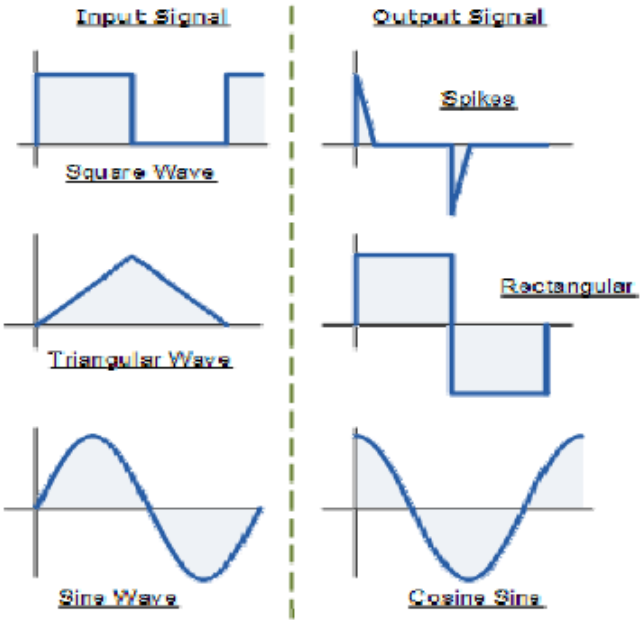
9. Observe the output of the circuit on the CRO which is a spike wave and note down the position, the amplitude and the time period of Vin & Vo.

10. Plot the output voltages corresponding to square and sine wave inputs.

TABULAR COLUMN:

Sr.No.	I/P Voltage Vin	O/P Voltage Vo	Frequency in KHz.

EXPECTED WAVEFORMS:



WORKSHEET:

Input Waveform:

Output Waveform:

RESULT:

Hence an op-amp differentiator simulates mathematical differentiation of the input voltage waveform.Output of an differentiator using op-amp 741 for a given input signal is observed and plotted .From this we can conclude that the differentiator using IC 741 OP-AMP is satisfying its function properly.