

EXPERIMENT VIII

FIRST ORDER CIRCUITS

OBJECT:

In this experiment you will learn the following things:

- 1) i. Experimental observation of the first order circuit characteristics for capacitive and inductive circuits.
- ii. Finding time constant experimentally.

EQUIPMENT LIST:

DSO,

Agilent Function Generator,

Op-Amp ($\mu A741$),

Diode (1N4007),

Capacitors (10nF, 4.7 nF, 47 nF, 2 x 1 μ F),

Inductor (0.1H),

Resistors (1.2 k Ω , 1.8 k Ω , 2.2 k Ω , 2 x 3.3 k Ω , 10 k Ω , 68 k Ω).

LED x 4

PRELIMINARY WORK:

- 1) Consider the circuit and the input voltage waveform $v_{in}(t)$ of Fig.8.1. Take $V_1=1V$ and $V_2=3V$.

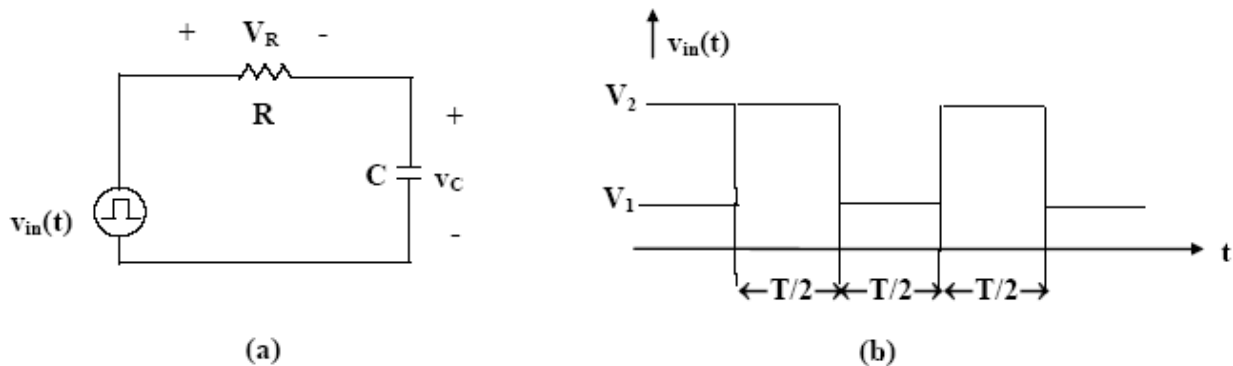


Fig. 8.1

- a. Obtain the differential equation and for the values of f , R , and C in Table 8.1, determine and sketch $v_C(t)$ and $v_R(t)$. Calculate the time constant τ in each case.

f (kHz)	R (k Ω)	C (nF)
2	3.3	4.7
2	3.3	10
2	68	10

Table 8.1

- b.** Replace the capacitor C in Fig.8.1 (a) with an inductor L. Obtain the differential equation and for the values of f, R, and L in Table 8.2, determine and sketch $v_L(t)$ and $v_R(t)$ for the input in Part 1. Calculate τ in each case.

f (kHz)	R (k Ω)	L (H)
2	3.3	0.1
2	1.8	0.1
10	3.3	0.1

Table 8.2

- c.** How can τ be found experimentally from the voltage waveforms seen on DSO screen?

Hint: Consider the exponential characteristics of voltage waveforms in one interval.

- 2) a.** Find the expressions relating $v_o(t)$ to $v_{in}(t)$ for the following differentiator circuit, where $v_{in}(t)$ is a triangular wave of 2V p-p with 0V DC offset and $f = 500$ Hz. Sketch the input and output voltage waveforms.

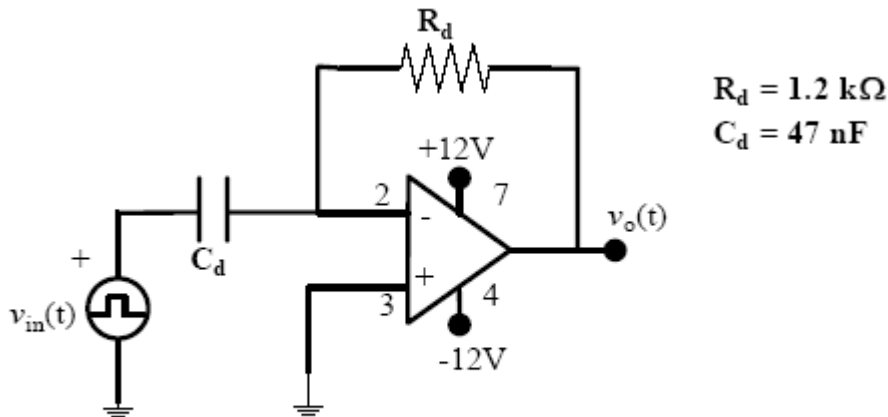


Fig. 8.2

b. Find the expressions relating $v_o(t)$ to $v_{in}(t)$ for the following integrator circuit, where $v_{in}(t)$ is a square wave of 2V p-p with 0V DC offset and $f = 500$ Hz. Sketch the input and output voltage waveforms.

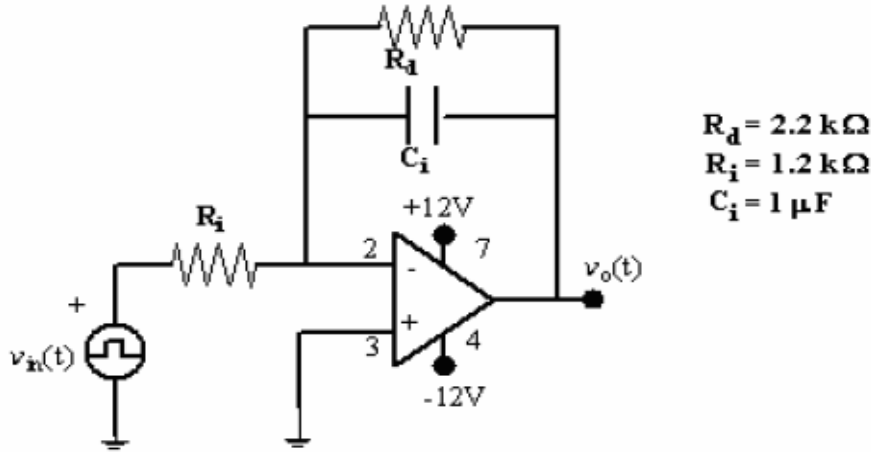


Fig. 8.3

EXPERIMENTAL WORK:

1) Adjust the square wave output of the function generator as in Preliminary Work Part 1.

a. Set up the circuit of Fig. 8.1(a). For the values of f , R , and C in Table 8.1, observe and plot the voltage waveforms $v_{in}(t)$, $v_C(t)$ and $v_R(t)$ by making necessary probe connections considering that the function generator is grounded output at the given frequencies. Determine the time constants τ of the circuits experimentally.

In order to plot $v_R(t)$, you can use the MATH facilities of the DSO.

b. Replace the capacitor C with the inductor L and repeat Part 1.a for the values of f , R , and L in Table 8.2.

2) Set up the circuit given below. Set the DC offset of the square wave to zero, $f = 100\text{Hz}$ and peak level to 3V for the function generator. Plot the waveform for V_1 . Determine the time constant of the circuit at different time intervals.

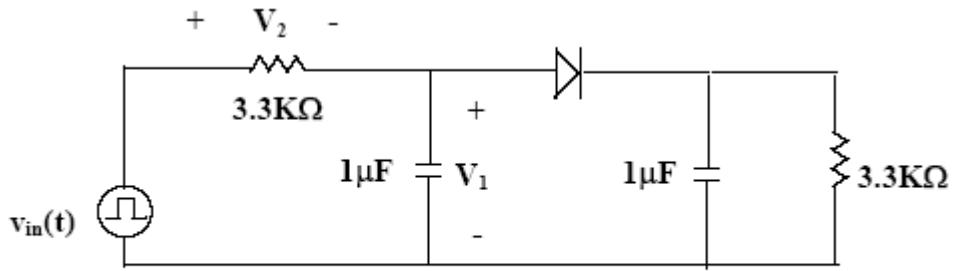


Fig. 8.4

3) Set up the circuits in figures 8.2 and 8.3. Observe and plot input and output voltage waveforms.

Optional

4) * Set up the Full Wave Rectifier circuit in figure 8.5 by using **Light Emitting Diodes (LEDs)**. Observe the functioning of the LEDs and understand how they operate.

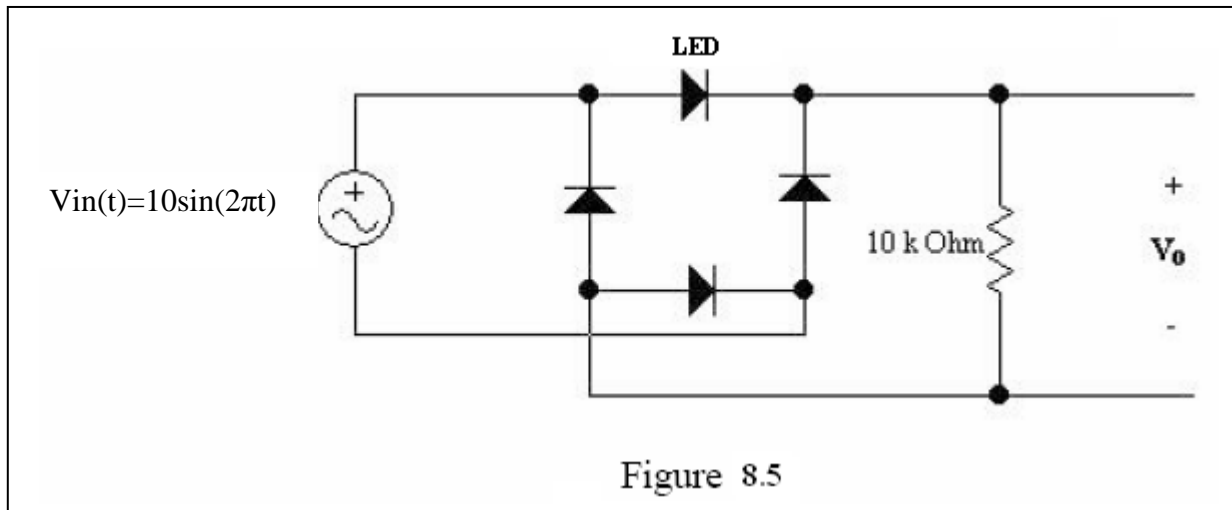


Figure 8.5