<u>Electrical Engineering Department</u>
<u>Network Lab.</u>

Part:-1

Estimation of Fourier Coefficients of a Periodic Signal

<u>Objective</u>: - Experimental verification of Fourier Coefficients of a square wave Signal using passive network.

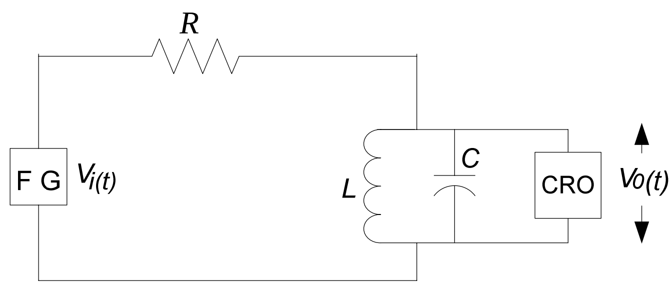

Fig.- E 4a.

Procedure:

Part I.

Step - 1. Select the network component values as follows.

$$\left.\begin{array}{l} R = 100K\Omega \\ L = 10mH \\ C = 100nF \end{array}\right\} \text{------------------ (4.1)}$$

Step - 2. Set the sinusoidal output from the signal generator $(V_i(t))$. Amplitude of $V_i(t)$ should be around 3Volt and the frequency (f) should be $100Hz$.

Step - 3. Measure the corresponding amplitude of $V_0(t)$. The gain G is defined as below.

$$G(2\pi f) = \frac{\text{Amplitude of } V_0(t)}{\text{Amplitude of } V_i(t)} \qquad \text{-------------------- (4.2)}$$

Step - 4. Vary the output frequency (f) of the function generator from $100Hz$ to $100KHz$. Measure the corresponding gain $G(2\pi f)$. Plot in semi-log paper f versus $G(2\pi f)$ in dB scale.

Step - 5. Using Laplace Transformation, derive the transfer function $G(s)$ of the network shown in figure E-4 with parameters given in the equation (4.1).
Plot the approximate frequency response (Bode plot) and compare with the plot obtained experimentally in step 4.

Part II.

Step - 1. Select the network component values as done in part I. Set the square wave output from the signal generator $(V_i(t))$. The amplitude of $V_1(t)$ should be around 3 volt and the frequency should be around $15KHz$.

Step - 2. Fine tune the frequency of the signal generator so that the $V_0(t)$ becomes simusoidal with highest amplitude. Measure this frequency and the amplitude of $V_0(t)$.

Step - 3. Choose different combinations of L and C (vary the components in orders) and repeat the step-2.

Step - 4. Observe that the $V_0(t)$ has the same magnitude for various combinations of L and C. This is the fundamental Fourier series coefficient of the square wave signal. Compare with its theoretical value.

Part III.

Step - 1. Select the network component values as done in part I. Set the square wave output from the signal generator so that the $V_0(t)$. The amplitude of $V_i(t)$ should be around 3 volt and the frequency should be around $5KHz$.

Step - 2. Fine tune the frequency of the signal generator so that the $V_0(t)$ becomes almost sinusoidal Measure this frequency and the amplitude of $V_0(t)$. Note the amplitude of $V_0(t)$ is varying periodically. Take the average value of them. This is the 3rd harmonic Fourier series coefficient of the square wave signal. Compare with its theoretical value.

Step - 3. Similarly, obtain the 5th harmonic Fourier series coefficient of the square wave signal. Compare with its theoretical value.

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Study of a nonlinear element in network

Objective: - Derivation of $V-I$ characteristic of a diode. Model a nonlinlinear circuit using diode as piecewise linear and then comparison its theoretical and experimental transient response.

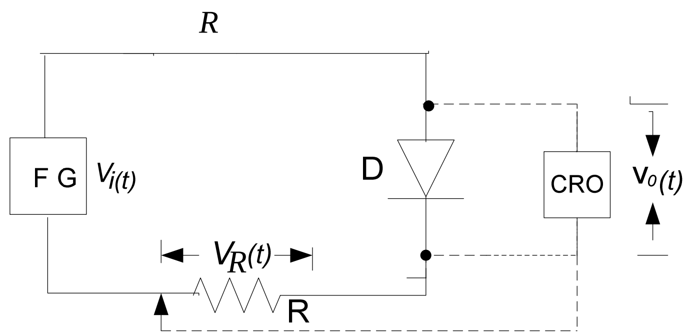

Fig. *E 4 b – 1.*

Procedure:-

Part – I.

Step - 1. Select the network component values as follows.
$R = 100\Omega.\ \geq 500mA$
$D = 1N4148.\ \ 200mA.\ \ 100V$

Step - 2. Set the sinusoidal output from the signal generator $(V_i(t))$. Amplitude of $V_0(t)$ Should be around 5 Volt and the frequency (f) should be $1KHz$.

Step - 3. Invert the channel 2 set the display in X-Y mode. Record the plot from the oscilloscope for the $V-I$ characteristic of the diode (I N4148).

Step - 4. Based on the above $V-I$ characteristic develop a two-segment piecewise linear $V-I$ model for the diode.

Experimental Setup Part II:

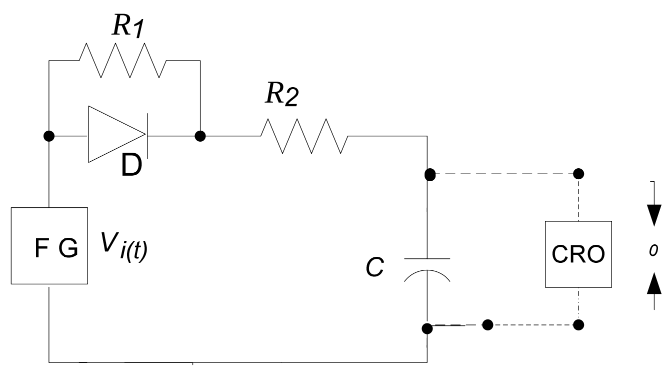

Fig :- *E 4 b II .*

Procedure:

Part – II.

Step - 1. Select the network component values as follows.

$$R_1 = 1K\Omega, \geq 500mA$$

$$R_2 = 100\Omega, \geq 500mA$$

$$C = 1\mu F$$

$$D = 1N4148, 200mA, 100V$$

Step - 2. Apply a $100Hz$ bipolar square wave signal to the circuit and note down its response from the CRO.

Step - 3. Compare the response with that computed theoretically using the piecewise linear model developed in step 4 of part I.