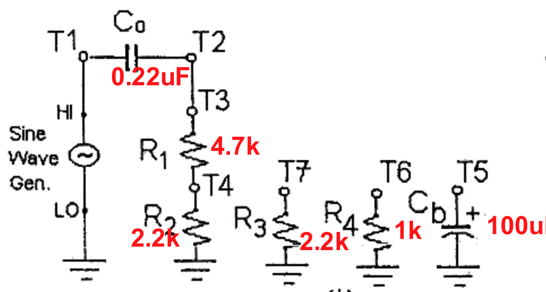
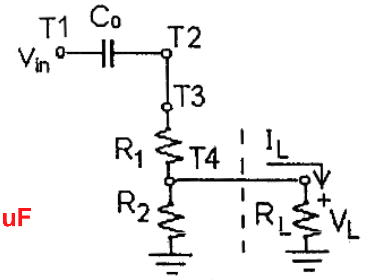
BASIC ELECTRONICS LABORATORY
EXPERIMENT NO: 2
FAMILIARISATION WITH SIGNAL GENERATOR, OSCILLOSCOPE AND STUDIES ON RC, CR, and RL CIRCUITS



(i)



(ii)

I. EXPERIMENT:

VOLTAGE DIVIDER:

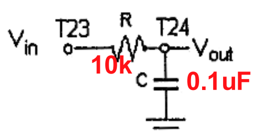
(i) Connect the voltage divider circuit shown in Fig.(i) and Fig.(ii).

(ii) Set the signal generator to produce a 6 V p-p , 20 KHz sine wave. Apply this signal to CH1 (Y1) of your scope and measure/trace its amplitude and frequency; see **Note I** below.

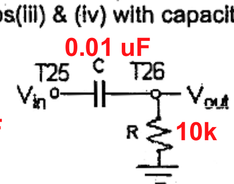
(iii) Display and measure V_L, Fig.(ii), in CH2 (Y2) for the cases where **(a)** $R_L = \infty$, i.e. no load case, **(b)** $R_L = R_3$ (by connecting T7 to T4 , Fig.(i)), **(c)** $R_L = R_4$ (by connecting only T6 to T4), **(d)** $R_L = R_3 \parallel R_4$ (by connecting T6 & T7 to T4),

(iv) Compare these with V_L calculated using Thevenin model (Remark, note that for 20 KHz: $|X_0| = 1/\omega C_o << R_1$).

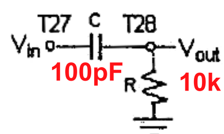
(v) Repeat steps(iii) & (iv) with capacitor C_b parallel to R_L (i.e. join in addition T5 to T4).



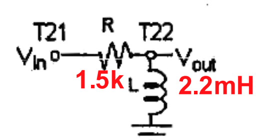
(iii)



(iv)



(v)



(vi)

II. EXPERIMENT:

FRQUENCY RESPONSE:

(a) ***R-C Network***:

(i) Record R & C values in Fig.(iii).

(ii) Apply a sine wave signal V_{in} of about 1.2V p-p. Display and measure this signal in the Scope's CH1 (Y1).

(iii) Display and measure V_{out} in CH2 (Y2).

(iv) Maintain constant input amplitude, vary frequency in convenient steps over the range of your signal generator (at least from 10 Hz to 500KHz). Use step size such that less (more) readings are taken when V_{out} varies slowly (fast).

(v) Plot V_{out}/V_{in} vs. frequency. See **Note II** below. Determine filter type.

(vi) Record the 3 dB cutoff frequency f_C.

(vii) Compare with the theoretical $f_C = 1/2\pi RC$.

(b) ***C-R Network:***

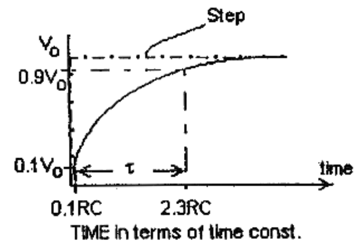
(i) Record the R & C values in Fig.(iv).

(ii) Repeat steps a(ii) to a(vii).

P.T.O.

(iii) Record the R & C values in Fig.(v).
(iv) Repeat steps a(ii) to a(vii).

(c) *R-L Network:*
(i) Record the value of R in Fig.(vi). Here $L \approx 2.2mH$.
(ii) Repeat steps a(ii) to a(vi).
(iii) Compare with the theoretical $f_C = R/2\pi L$.

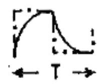


(vii)

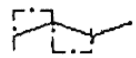
III. EXPERIMENT:

PULSE RESPONSE:

(i) Set the signal generator to produce a 1.2 V p-p pulse (or square) waveform. Apply this signal to CH1 (Y1) of your scope and measure/trace its amplitude and pulse repetition frequency (PRF = 1/T).
(ii) Obtain/trace the indicated displays with the help of the typical oscilloscope settings shown in the table below. Your settings may differ due to component variations from board to board.



(viii)


(ix)


(x)

Circuit	V_{out} displayed in CH2	PRF	Time/div	Volts/div for Output Display	Case
R-C, Fig.(iii)	Fig.(viii)	150 Hz	1ms	0.2 V	T>>RC
R-C, Fig.(iii)	Fig.(ix)	1.5 KHz	0.2 ms	0.1 V	T<<RC, integrator
C-R, Fig.(v)	Fig.(x)	1.5 KHz	0.1 ms	0.2 V	T>>RC, differentiator
R-L, Fig.(vi)	Fig.(x)	15 KHz	50 μs	0.2 V	T>>L/R, differentiator

(iii) For Fig.(viii) type response measure the rise time using Fig.(vii). Compare this with the theoretical: $\tau = 2.2\ RC = 0.35/f_C$, where f_C is the 3 dB cutoff frequency or Low Pass Filter bandwidth.
(iv) Obtain a variety of results using other values of PRFs.
(v) Obtain comparable results for the circuit of Fig.(iv).

NOTE:

1. **Typical Oscilloscope Settings:**

Be certain that all scope controls are in their "**Calibrated**" position and that you know the horizontal and vertical sensitivity (scale factors) of the display.

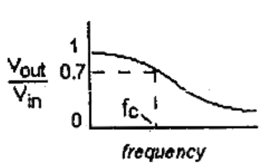
Signal Input to:	CH1 (Y1)	CH2 (Y2)	Both the channels CH1 & CH2
Select Trigger Source From:	CH1 (Y1)	CH2 (Y2)	Channel having the larger amplitude signal

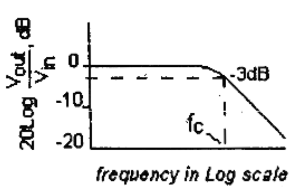
Adjust Vertical and Horizontal shift controls to centre the display.
Adjust Trigger Level control to stabilize the display.

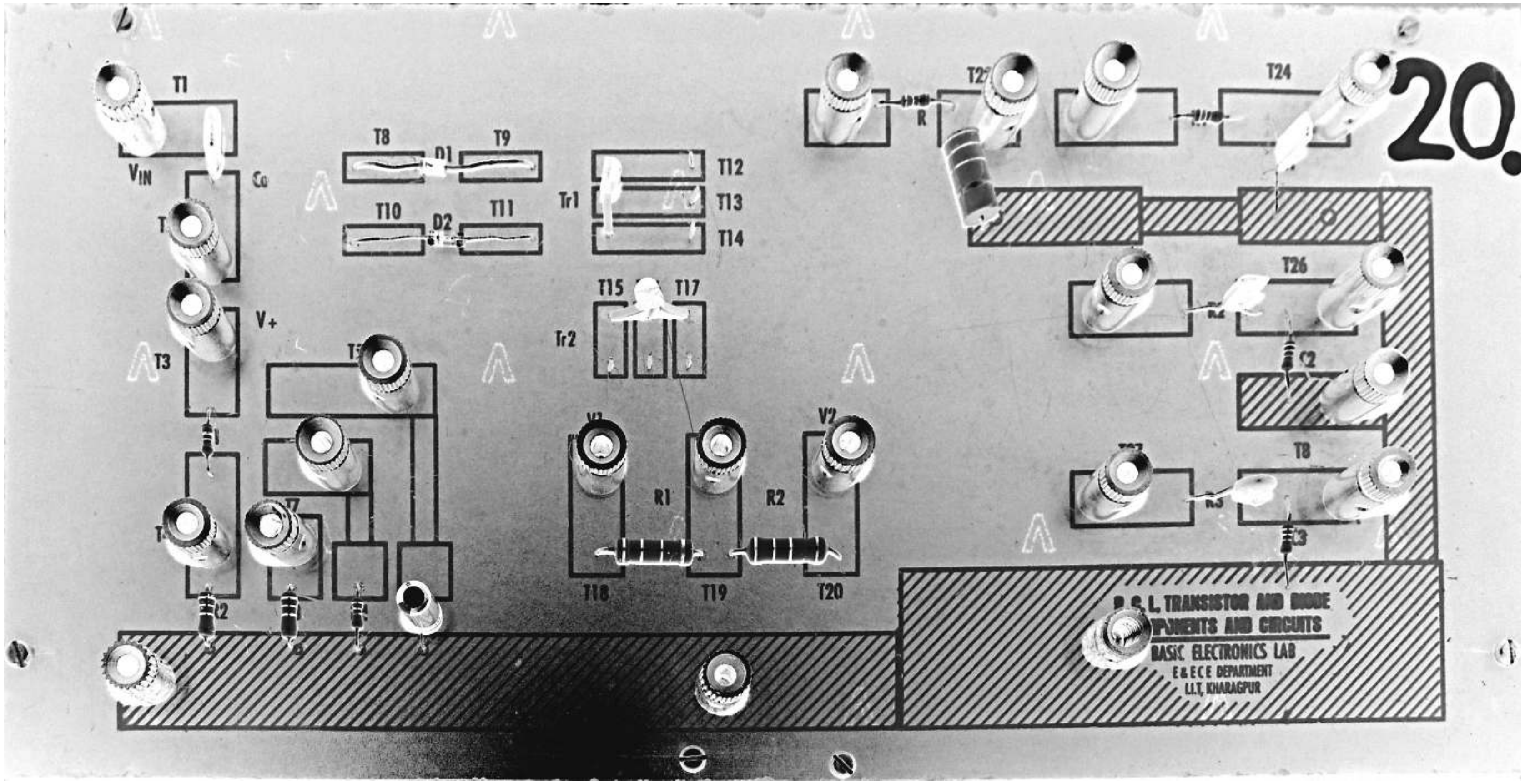
Signal Freq	1Hz	10Hz	100Hz	1KHz	10KHz	100KHz
Time/div	0.1ms	20ms	5ms- 1ms	1ms-0.1ms	0.1ms-10μs	10μs- 1μs

Signal Amp	20 V p-p	4V p-p	0.4V p-p	40mV p-p	10mV p-p
Volts/div	10V – 5V	2V - 0.5V	0.2V – 0.05V	20mV- 5mV	5mV- 2mV

II. **Log-Log Plots:** Signal amplitudes seem to vary slowly with frequency in the scope whereas that in the texts show sharp changes. This is an effect of the compression of the axes on the usual (Text's) graph. The scopes signal varies linearly; the text's version is log-log.







- Discrete components (R, C, diodes, transistors) on left-hand-side of the measurement-board are meant for Experiment 01
- R-C, C-R, R-L circuits on the right-hand-side are meant for Experiment 02