Familarization with electric components and usage of multimeter

Aim:- To know the characteristics of electric components and usage of multimeter

Apparatus required:-

S.No.	Component name	Quantity
1.	Digital multimeter	1
2.	Resistors	-
3.	Inductors	-
4.	Capacitors	-
5.	Transistors	-
6.	Bread board	1

Theory:-

1) **Resistor:-** It is a passive element. it oppasses the flow of current. resistor works on the principle of ohm's law. i.e. voltage across the terminals of a resistor is directly propotional to the current flowing through it.

Resistor 

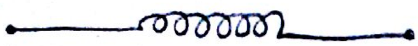
Colour Coding :- B B R O Y G B V G W

0 1 2 3 4 5 6 7 8 9

= BBO ± T

$10 \times 10^3 = 10 k\Omega \pm T$

Inductor :-

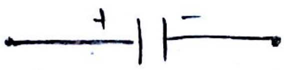


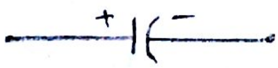
B Y Gold silver

$17 \times 0.1 \pm T$

$\Rightarrow 1.7 \mu H$

Capacitor :-

Disc type : 

Electrolytic : 

Disk

$= 10 \times 10^4 pF$

$= 100 nF$

: Electrolytic

$C = 1 \mu F$

$V = 50V$

$$I \propto V$$

$$I = \frac{V}{R}$$

units of resistor is ohms (Ω).

Types of resistors:-

Resistors Can be broadly Classified based on the following Criteria. The types of material used, the power rating and resistance value.

(1) Fixed resistors
(2) Carbon Composition resistors
(3) Carbon film resistors.

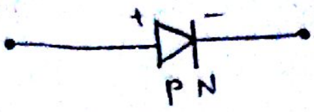
Resistance of a particular Component is depends upon ρ, A of Component.

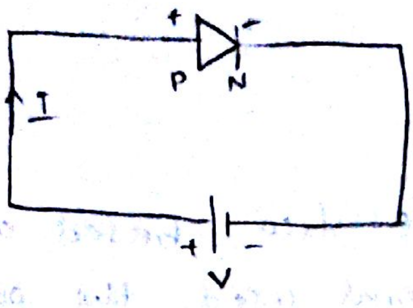
$$R = \frac{\rho l}{A}$$ Here l = length of wire
A = cross sectional area
ρ = resistivity

(2) Inductor:-

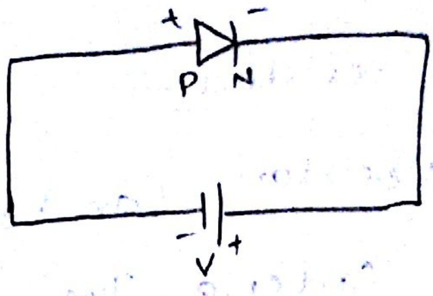
An inductor is a passive electrical Component which resists the charges in electric current passing through it. It Consists of a Conductor such as wire, usually wound into a coil. when a current flows through it energy is stored temperorly in a magni~~tude~~ic field in the coil.

Diode :-





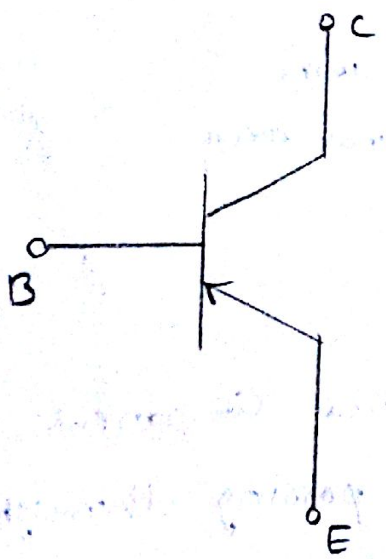
Forward Biased



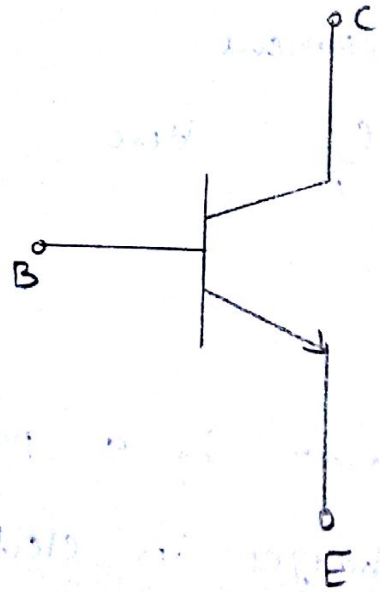
Reverse Biased

Transistor :-

PNP



NPN



when the current flowing through an inductor changes the time varying magnetic field induces a voltage in the conductor. According to the Faraday's law of electromagnetic induction which of the change in current that created it.

units of inductor is henry (H).

$$v(t) \propto \frac{di}{dt}$$

$$v(t) = L\frac{di}{dt}$$

The power entering into an inductor will be 0.

$$P = IV = Li\frac{di}{dt} \quad . \quad \frac{di}{dt} = 0 \Rightarrow P = 0$$

(3) Capacitor:-

It is a passive element which has the ability to store energy in the form of an electrical charge.

units of Capacitor is Faraday (F).

Types of Capacitor:-

(i) Ceramic Capacitor:- It is a non-polarised fixed capacitor made up of two (or) more alternating layers of ceramic and metals in which the ceramic materials acts as the dielectrical and the metal acts as electrodes.

(ii) <u>Electrolytic Capacitor</u>:– It is a polarised electrolytic capacitor having a metallic anode covered with an oxidized layer used in dielectrics.

(3) <u>Diodes</u>:–

It is a semiconducting device. It has two terminals and it has low resistive to the current flow in one direction and high resistance in the other. The semiconductor diode is the most common diode in usage.

Diodes are two types: (1) p-type (2) n-type.

(4) <u>Transistors</u>:–

It is a electric component having 3 terminals capable of amplification in rectification.

Transistors are two type :– (i) p-n-p transistor

(ii) n-p-n transistor

(5) <u>Multimeter</u>:–

It is an electronic measuring component that can measures several measurements fractions in one unit by using multimeter we can measure the value of resistance, current, voltage and break-down voltage of a Transistors.

Procedure:-

(1) Take the given Components and identify them.

(2) Take the resistor and observe the Colour code on it. and resistance of it by using colour Code & Compare that value by using multimeter.

B	B	R	O	Y	G	B	V	G	W
black	brown	red	orange	yellow	Green	blue	violet	grey	white
0	1	2	3	4	5	6	7	8	9

gold: 5% tolerence

silver: 10% tolerence

no-colour: 20% tolerence

(3) Distinguish different types of Capacitors & inductors and find values using given code.

(4) Inductor looks like a resistor, but the ends of inductor are bulkey, the value of this is formed as same as resistor.

(5) Transistor has three electrodes they are collector, base, & emitter

(6) Diode has two electrodes. A white strip is −ve that is n-type.

(7) All the values of Components are measured by the multimeter & tabulated.

Observation:-

① Theoretical & practical values of all the Components are approximately same.

② when we Connect the multimeter prob to the diode by selecting the knob it diode figure. multimeter displays the barrier potentials of the diode.

Result:-

We successfully Completed the familarization of electric Components and the usage of multimeter.

Thus, the electronic Components were observed and Calculated their values.

Familarization with oscillating Oscilloscope, signal generator and further usage of multimeter.

Aim:- To familarize with signal generator and oscilloscope and to observe different types of wave forms in CRO generated by signal generator

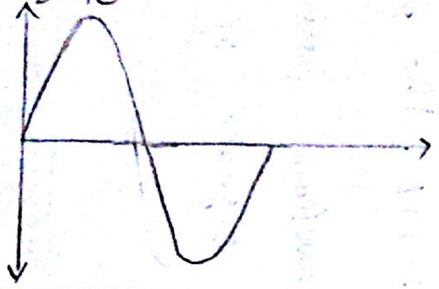
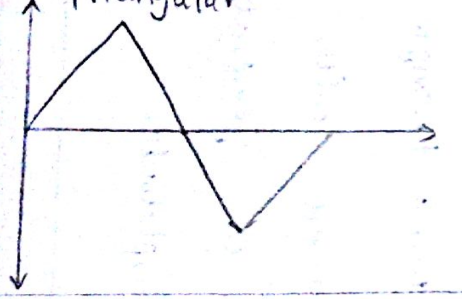
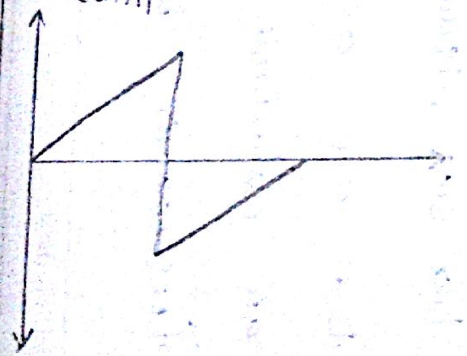
Apparatus required:-

S.No.	Name of equipment	Range	Quantity
1.	Cathoderay oscilloscope	0-30 MHz	1
2.	Function generator	0-3 MHz	1
3.	Connecting probes	-	3

Theory:-

Function generator:-

function generators produces several types of signals like sine, square, ramp, triangle & TTL. The parameters that are associated with waveform such as amplitude are adjustable. It can generates signals of various frequencies & amplitudes

S.No	Type of Waveform	Amplitude			Time Period			Frequency $f = \frac{1}{T}$ Hz
		No. of divisions on Y-axis (a)	Volts/div (b)	a×b	No. of divisions on x-axis (a)	Times/div (b)	a×b	
1.	Sine 	2.1	0.5	1.05	1.5	2 msec	3 msec	333.3 Hz
		2.2	0.5	1.1	0.4	1 msec	0.4 msec	2.5 kHz
2.	Triangular 	3	0.5	1.5	0.5	2 m sec	1 msec	1 kHz
		3.1	0.5	1.55	0.7	50 μsec	35 μsec	28.57 kHz
		3.2	0.5	1.6	0.6	5 μsec	3 μsec	333.3 kHz
	Ramp 	2.4	2	4.8	0.7	2 msec	1.4 msec	714 Hz
		2.4	2	4.8	0.5	1 msec	0.5 msec	2 kHz
		2.5	2	5	0.6	10 μsec	6 μsec	170 kHz

Parts of function generator:-

1. Power:- push button switch to power on to control the power supply

2. LCD Display:- Characters bring back liquid crystal display.

3. Frequency:- Used for selection of frequency range step by step

4. Function:- It is used to select the different wave forms, those are sine, square, Triangular, TTL, Ramp. & pulse wave forms.

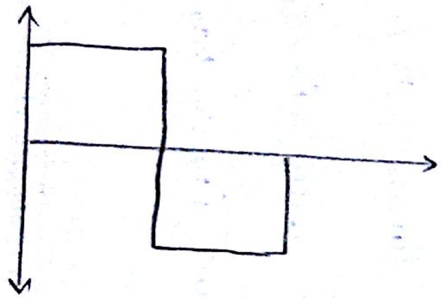
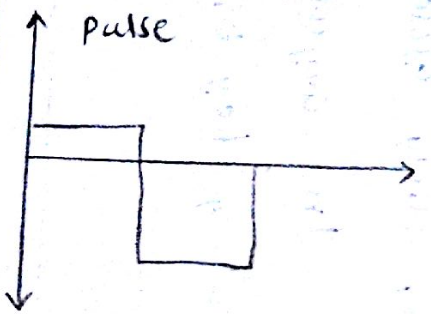
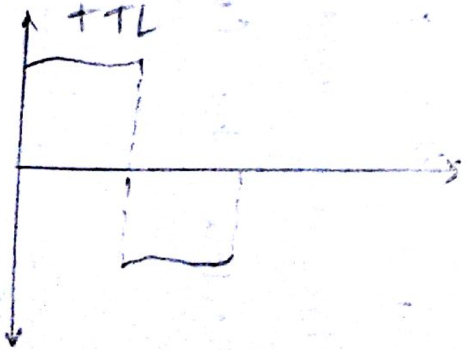
5. Modulation:- Various kinds of modulations are available like Ams, Amp, FM, AM etc.

6. Attenuation. It adjusts the output amplitude with respect to input amplitude. The available ranges are 0dB, 20dB, 40dB.

7. Menu: Used for selection of function of function generator.

8. Duty cycle:- when pulse output function is selected this controls the power duty cycle forms 15% to 85%.

9. Frequency variable:- In conjuction with frequency range selected by frequeny key ~~to~~ on front panel

S.No	Type of waveform	Amplitude			Time Period			Frequency
		No. of divisions on Y-axis (a)	Volts/div (b)	a×b	No. of divisions on X-axis (a)	Time s/div (b)	a×b	$f = \frac{1}{T}$ Hz
04.	Square wave 	3.2	0.5	1.6	2.3	0.2 msec	0.46 msec	2.17 kHz
		3.2	0.5	1.6	1.4	2 msec	2.8 msec	377.1 kHz
05.	pulse 	2.1	2	4.2	2.2	20 μsec	44 μsec	22.72 kHz
		2.2	2	4.4	3.1	1 μsec	3.1 μsec	322 kHz
06.	TTL 	2	2	4	2.4	0.2 msec	4.8 msec	2.08 kHz
		2	2	4	3.3	1 μsec	3.3 μsec	303.1 kHz
		3.4	2	6.8	0.9	0.5 μsec	0.45 μsec	2.22 MHz

10. Amplitude Variable:- In conjuction with attenuation this varies the level of output.

11. DC off set:- This provides DC offset Approximately super imposed on the output. keep the Control of it. DC offset is not required.

12. Modulation input:- Maximum modulation output is $2V_{pp}$.

CRO working principle:-

Most important components are of oscilloscope is Cathoderay tube. It is vaccum tube in which filament is heated. Electrons are ejected and move towards screen contain fluorescent material. It solves when it is hit by electron beam. The beam passes through the two sets of deflections plates.

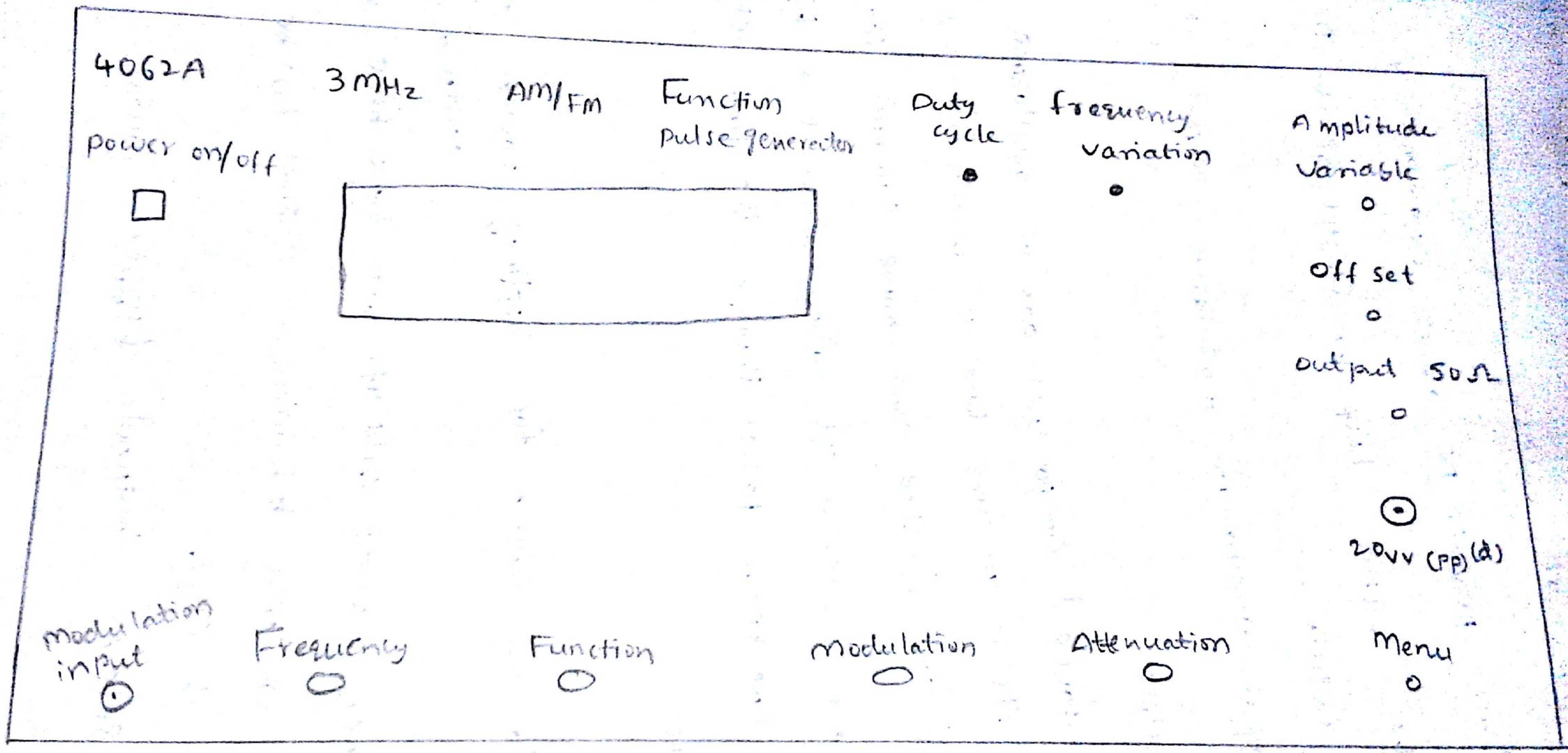
Parts of CRO:-

1) Power:- push to on switch for supplying power in instrument.

2. XY:- Switch when passed cuts off the time base and alway access to the external horizontal signal to be fed through CH_2.

3. CH_2:- Switch selects channels trigger source.

Function Generator:—



4. Auto/level :- Switch selects Autolevel position. Auto used to get trace when no signal is feed at the input. In level position the trigger level can be varied from the +ve peak to -ve peak with level controls.

5. X-shift :- Controls horizontal position of trace.

6. Intensity :- Controls the brightness of the trace.

7. Focus :- Controls the sharpness of the trace.

8. Y-shift 1 & 2 :- switch when pressed it This Control provides for vertical direction of trace for each channel

9. volt/div :- Switch selects volt/div setep for CH_2 & CH_1

10. Time/div: switch select time/div. setep.

Procedure :-

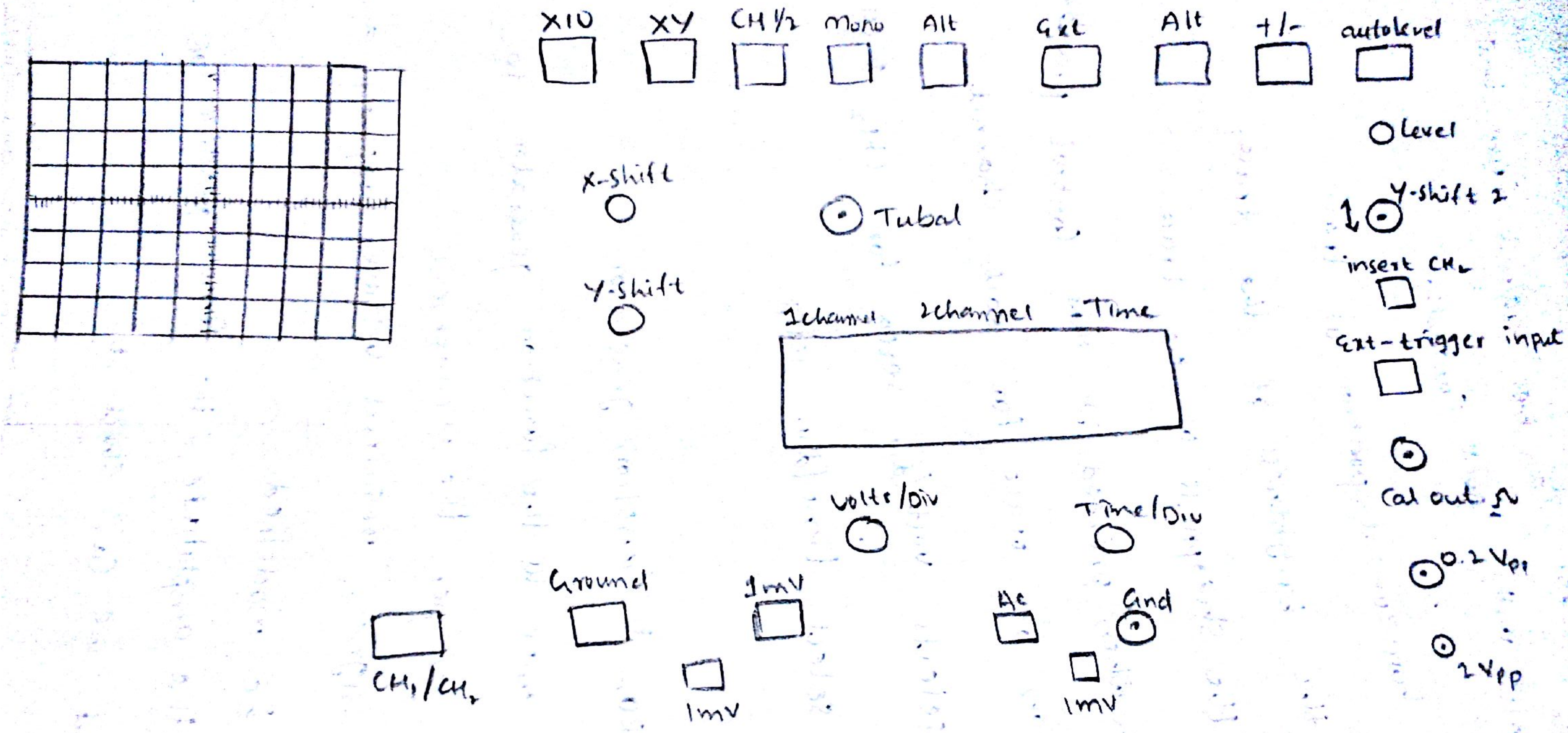
1) Switch on the CRO, & function generator.

2) Connect the load wire to the function generator to oscilloscope CH_1, CH_2 as per the requirement

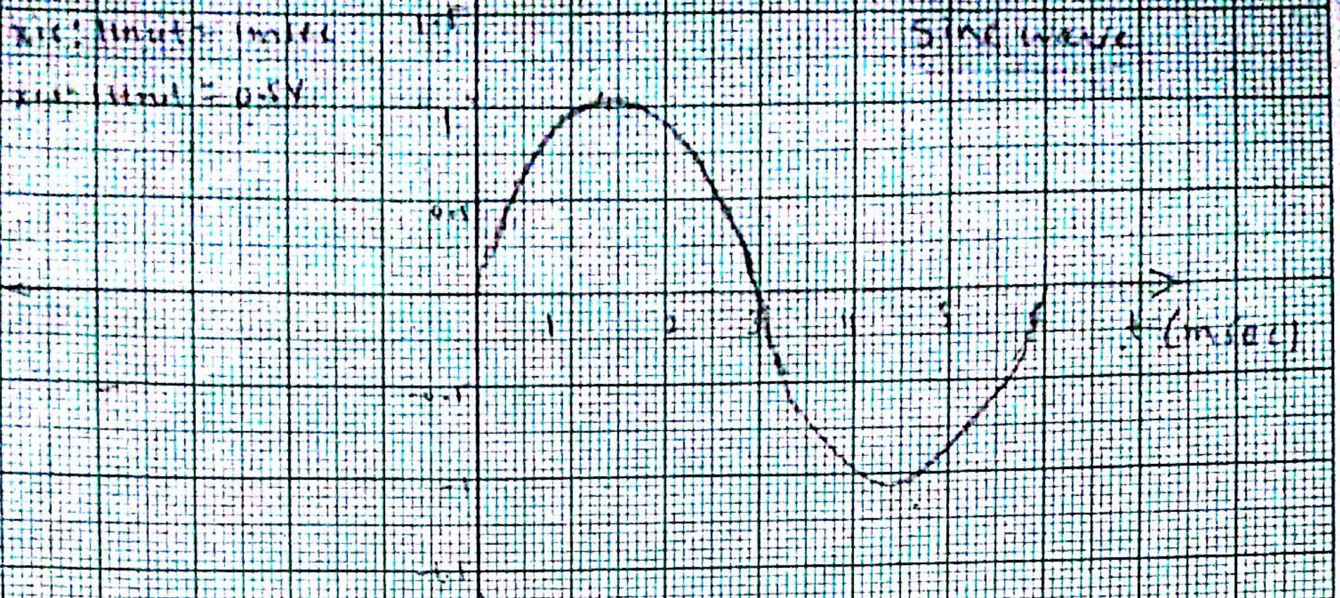
3. To generate the signal, required voltage supplied and frequency should be modified.

4. we also modify the amplitude, the time period of wave which generated and we can check it.

CRO (Cathode Ray Oscilloscope)



Scale:-
X-axis: 1unit = 1msec
Y-axis: 1unit = 0.5V

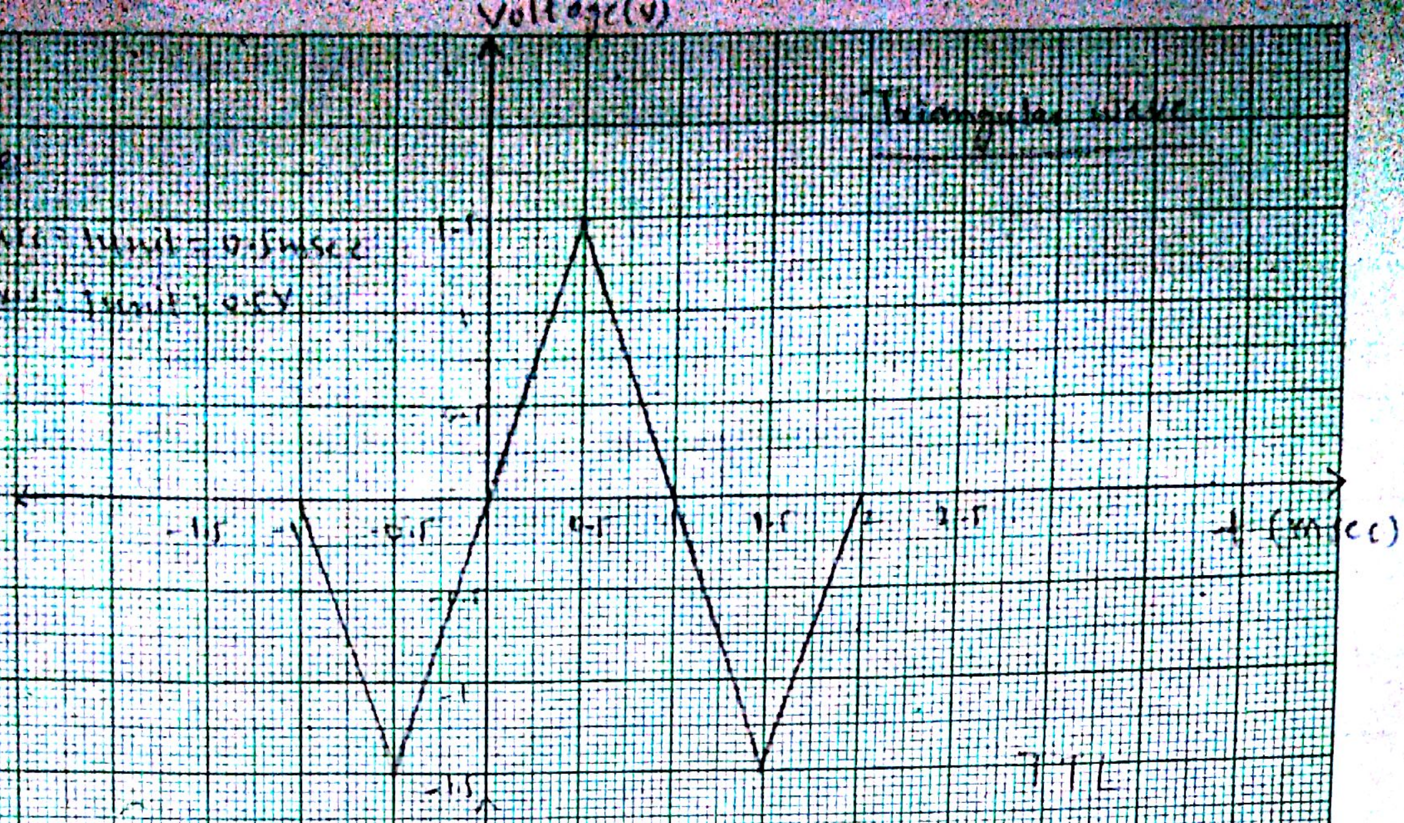


Triangular wave

Scale:

X-axis: 1 unit = 0.5 msec

Y-axis: 1 unit = 0.5 V



TTL

Scale

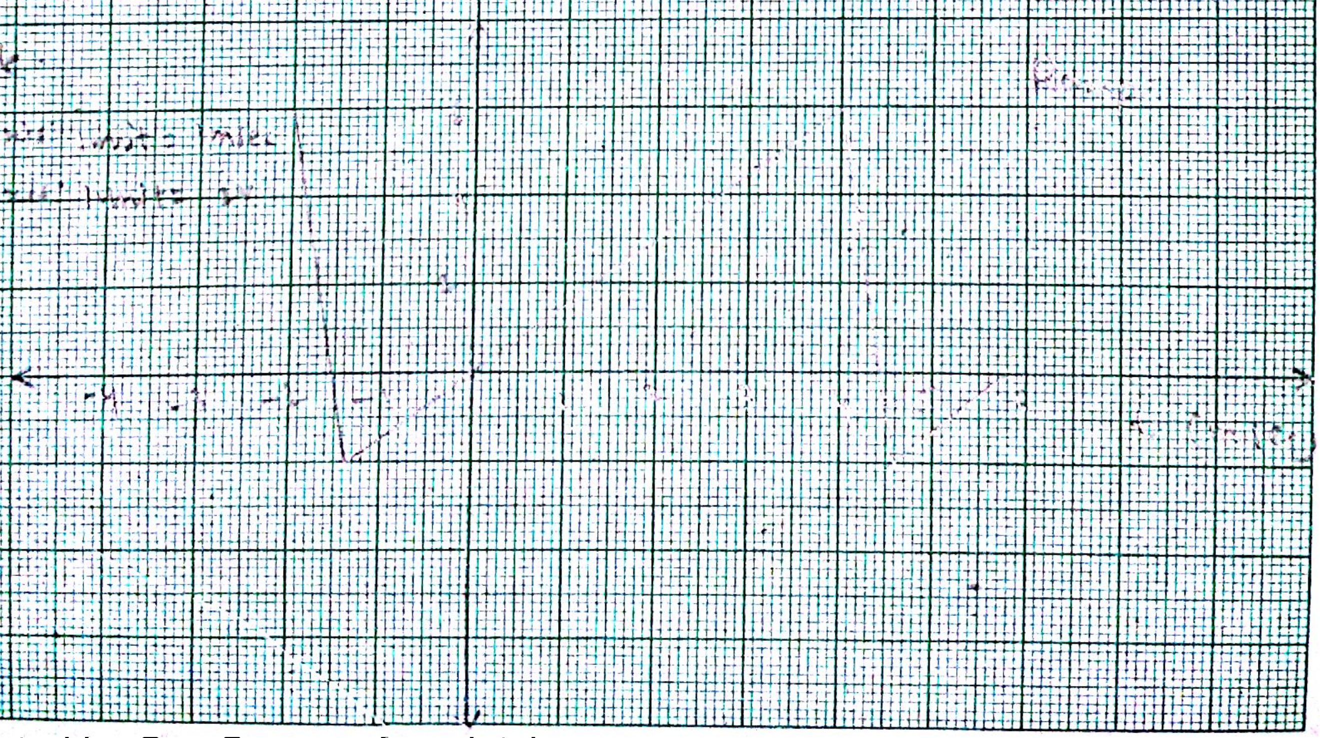
X-axis: 1 unit = 2 msec

Y-axis: 1 unit = 2V

Scale

X-axis: 1 unit = 1 msec

Y-axis: 1 unit = 5V



5. Calculate the voltage on y-axis by counting number of divisions and multiplied with CH_2 and CH_1 input voltage.

6. Calculated the time period on x-axis by counting no. of divisions multiplied with voltage

7. The reciprocal of time period gives frequency which gives the real frequency on generator. Like wise. we can check different types of waves.

Precautions:-

1) Carefully handle the CRO & function generator.

2) After completion of the experiment switch off the power supply

Result:-

We familarized with oscilloscope & signal generator and calculated the frequencies & amplitudes for different input signals.

Frequency Response of & Square wave rectify of RC, CR & RL Networks.

Aim:- To test the functionality of the circuits for sine wave input to draw the frequency responce and sine wave testing of RC & CR, RL Networks.

Apparatus required:-

S. No.	Apparatus name	Range	Quantity
1.	Resistor		1
2.	Capacitor		1
3.	Function generator	0-30 MHz	1
4.	CRO	0-3 MHz	1
5.	Inductor		1
6.	bread board		1
7.	probes		2
8.	Connecting wires		required

Theory:-

R-C Network:- It is a lowpass circuit which transmits only low frequency signals and attenuations high frequencies at '0' frequency. The signal of capacitance is infinite. i.e. the capacitor acts as an open circuit.

So the entire input appears and the input with zero alternatives. So the output is same as the capacitive resistance decreases $[X_C = \frac{1}{\omega C}]$, at every high frequency capacitor virtually acts as a short circuit & the output becomes zero. the frequency given $\frac{1}{\sqrt{2}}$ of it's maximum values is caused cut off frequency $f_c = \frac{1}{2\pi RC}$

CR-Network :- CR Networks is a high pass filter of zero. the frequency, the resistance offered by the capacitor is infinite. So it blocks the input and hence the output is zero. At very high frequency the capacitance is very small cut of frequency is $f_c = \frac{1}{2\pi RC}$

RL-Network :- RL Network which is high pass circuit when the frequency is '0'. the reactance of the inductor is '0'. thus the output is zero. when the frequency is infinite the inductor acts as open circuit thus the output is same as input

$$f_c = \frac{R}{2\pi L}$$

Procedure :-

1) RC Network:-

1) obtain the values of resistor & Capacitor

2) Connect RC Network as per Circuit. apply a sine wave signal V_{in} about of 1-2 V_{p-p} display & measure this signal in CRO's CH_2 Screen. display measure Vout in CH_2 CRO Screen.

3) Maintain Constant input amplitude, vary the frequency in Convenient steps over the range of your signal generator from 10Hz to 3MHz. Use step size that Less (more Readings are taken when volt varies slowly.

4) plot V_{out}/V_{in} frequency on a semilog sheet and determine the types of the filter record the 3dB, Cut of frequency Compare with the theoretical $f_c = \frac{1}{2\pi RC}$.

2) C-R Network:-

1) Obtain the value of resistor and capacitor. Connect CR network as per Circuit.

2) Apply a sine wave signal Vin of about 1-2 V_{pp}. display & measure this signal in the CRO's Screen.

3) Display & measure Volt in CRO's CH_1 Screen

4) Maintain Constant input amplitude vary frequency in Convenient step from range 100Hz to 1MHz

5) plot V_{out}/V_{in} Vs frequency on a Semilog sheet & determine the type of the filter.

6) ReCord the Cut-off frequency 'f_c' of at 3dB. Compare with the theoretical $f_c = \frac{1}{2\pi RC}$

3) <u>R-L Network</u>:-

1) Apparatus are taken with proper ranger. Resistor of 33Ω and inductor of 10mHz are taken

2) RL Circuit is Connected on bread board

3) Input about 1V is given to RL circuit different outpu levels are observed at different frequencies

4) From those value find out gain & gain dB.

5) plot graph between frequency and gain in dB on semilog sheet $f_c = \frac{R}{2\pi L}$

Precautions:-

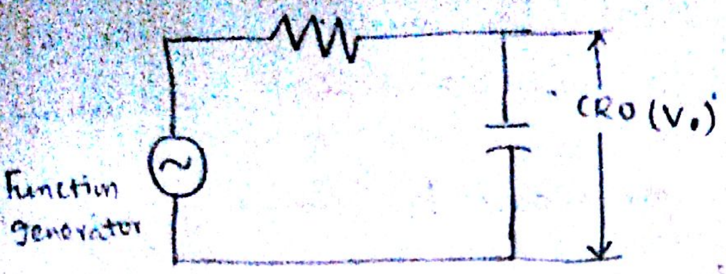
1) Check whether the circuit Connections are Correct (or) not before applying the power

2) Before changing a circuit ~~form~~ turn off the power supply

3) Wear the Shoes for Safety purpose.

Result:- The frequency response of RC, CR, RL is observed & calculated.

R-C Network :-



$R = 1.8 \times 10^3 \Omega$

$C = 103 \quad = 10 \times 10^3 \times 10^{-12} F$

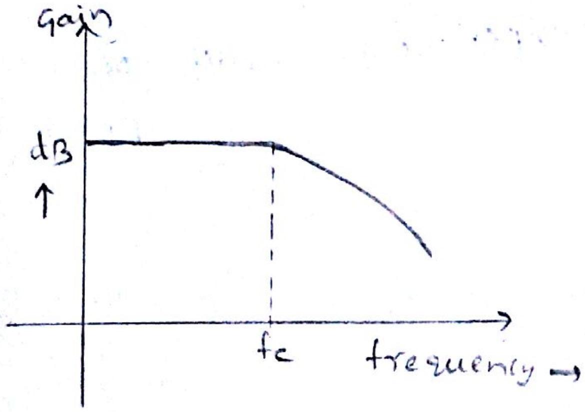
$= 10^{-8} F$

Formula :-

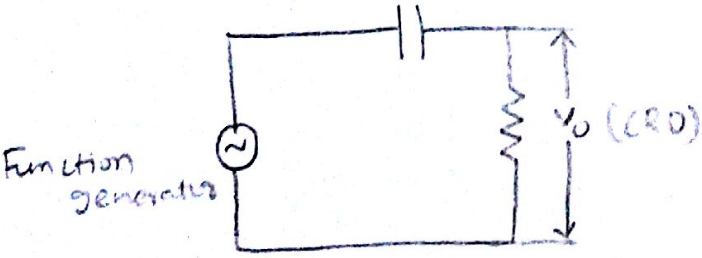
Cut-off Frequency (f_c) = $\frac{1}{2\pi RC}$

$f_c = \frac{1}{6.28 \times 1.8 \times 10^3 \times 10^{-8}} = 8.84 kHz$

Model graph :-



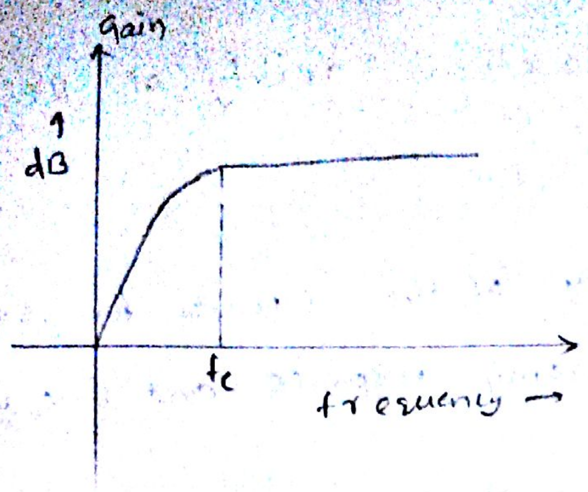
C-R Network :-



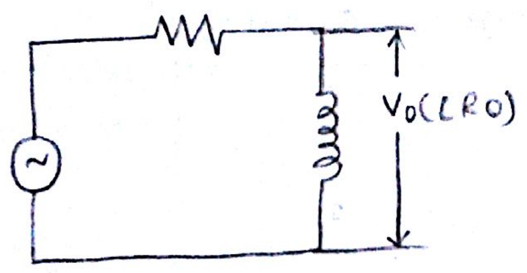
Cut-off frequency = $\frac{1}{2\pi RC}$

$= \frac{1}{6.28 \times 1.8 \times 10^3 \times 10^{-8}} = 8.84 kHz.$

Model graph :-



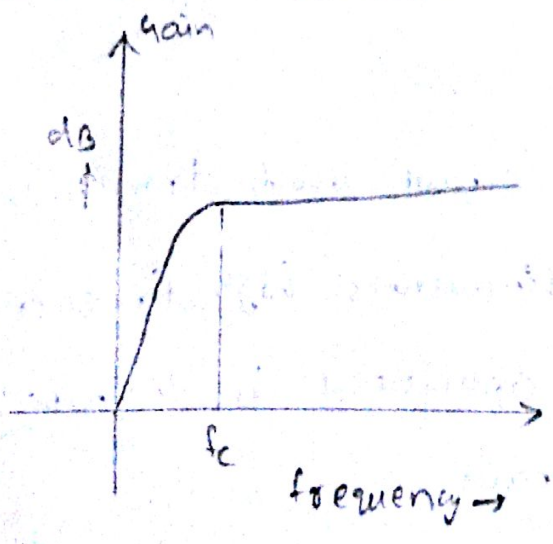
R-L Network :-



Cut-off frequency $(f_c) = \frac{R}{2\pi L}$

$= \frac{1.8 \times 10^3 \Omega}{2 \times 3.14 \times}$ =

Model graph:-



Observation Table:—

R-C Network:—

S.No.	Applied Frequency	Input voltage (V_{in}) (V)	Output Voltage (V_o) (V)	Gain $\left(\frac{V_o}{V_{in}}\right)$	Gain in dB $= 20\log\left(\frac{V_o}{V_{in}}\right)$
1.	6.07 kHz	10	1.45×5 = 7.25	0.72	−2.8dB
2.	7.09 kHz	10	0.7×10 = 7	0.7	−3dB
3.	7.53 kHz	10	1.45×5 = 7.25	0.72	−2.8dB
4.	8.07 kHz	10	1.4×5 = 7	0.7	−3dB
5.	f_c = 8.84 kHz	10	1.4×5 = 7	0.7	−3dB
6.	10 kHz	10	1.35×5 = 5.5	0.65	−3.4dB
7.	11 kHz	10	1.3×5 = 6.1	0.65	−3.74dB
8	12.17 kHz	10	1.2×5 = 6	0.6	−4.43dB
9.	13.06 kHz	10	1.15×5 = 5.5	0.55	−4.88dB
10.	14.92 kHz	10	1.1×5 = 5.5	0.55	−4.88dB

Observation table:-

C-R Network:-

S.No.	frequency	Input Voltage V_{in} (V)	Output voltage V_o (V)	Gain $\frac{V_o}{V_{in}}$	Gain in dB $20\log\left(\frac{V_o}{V_{in}}\right)$
1.	5.12 kHz	10	0.9×5 = 4.5	0.45	−6.9357 dB
2	6.1 kHz	10	1×5 = 5	0.5	−6.020 dB
3.	7.05 kHz	10	1.1×5 = 5.5	0.55	−5.1927 dB
4.	8.07 kHz	10	1.2×5 = 6	0.6	−4.43 dB
5.	fc = 8.84 kHz	10	1.4×5 = 7	0.7	−3 dB
6.	9.98 kHz	10	1.4×5 = 7	0.7	−3 dB
7.	11.15 kHz	10	1.4×5 = 7	0.7	−3 dB
8.	12 kHz	10	1.4×5 = 7	0.7	−3 dB
9.	13.5 kHz	10	1.4×5 = 7	0.7	−3 dB
10.	15.27 kHz	10	1.45×5 = 7.25	0.72	−2.853 dB

Generated by CamScanner from intsig.com

observation table:-

R-L Network:-

S.No.	frequency	Input voltage V_{in} (V)	Output voltage V_o (V)	Gain $\left(\frac{V_o}{V_{in}}\right)$	Gain in dB $= 20\log\left(\frac{V_o}{V_{in}}\right)$
1.	320Hz	2	0.35×2 = 0.7	0.35	−9.11 dB
2.	450Hz	2	0.4×2 = 0.8	0.4	−7.95 dB
3.	550Hz	2	0.4×2 = 0.8	0.45	−6.935 dB
4.	650Hz	2	0.5×2 = 1	0.5	−6.020 dB
5.	f_c = 754Hz	2	0.7×2 = 1.4	0.7	−3 dB
6.	2kHz	2	0.7×2 = 1.4	0.7	−3 dB
7.	2.53kHz	2	0.7×2 = 1.4	0.7	−3 dB
8.	2.79kHz	2	0.7×2 = 1.4	0.7	−3 dB
9.	3kHz	2	0.75×2 = 1.5	0.75	−2.498 dB
10.	3.12kHz	2	0.8×2 = 1.6	0.8	−1.938 dB

Half wave and Full-wave rectifier's rectification with Capacitive filters, zener diode and IC regulation.

Aim:- To ~~set~~ test the functionality of half wave and full-wave rectifier and bridge rectifiers through measurement of regulation and ripple factor.

Apparatus required:-

S.No.	Equipment name	Range	Quantity
1.	Bread Board	—	1
2.	CRO	0 – 3 MHz	1
3.	Function generator	0 – 3 MHz	1
4.	Connecting wires	–	required
5.	Resistors	—	3
6.	Capacitors	—	1
7.	Diodes	–	2
8.	Rectifier kit	—	1

Theory:- Rectifier is a Circuit with one (or) more diodes to Convert AC to DC (Pulsating) voltage. Those are 3 types

1) Half-wave
2) Full-wave
3) Bridge-wave rectifier.

Half-wave rectifier:-

This rectifier Converts the AC to DC only during the +ve half-cycle. During the -ve half-cycle the rectifier doesnot conducts. hence no voltage appears across the load after every half-cycle.

$$V_{dc} = V_{avg} = \frac{1}{2\pi}\int_0^{2\pi} v(t)dt$$

$$= \frac{1}{2\pi}\int_0^{2\pi} V_m \sin\theta d\theta$$

$$= \frac{1}{2\pi}\int_0^{\pi} V_m \sin\theta d\theta$$

$$V_{dc} = \frac{V_m}{\pi} = (-\cos\theta)_0^{\pi} = \frac{V_m}{\pi}$$

$$V_{AC} = V_{rms} = \sqrt{\frac{1}{2\pi}\int_0^{2\pi}(V_m \sin\theta)^2 d\theta} = \frac{V_m}{2}$$

$$V_{r(rms)} = \sqrt{V_{rms} - V_{dc}^2}$$

$$\text{ripple factor} = \frac{V_{r(rms)}}{V_{dc}} \times 100\%$$

Half wave rectifier with Capacitor filter

$$V_{dc} = V_m - \frac{V_p}{2}$$

$$V_{ac} = V_{r(rms)} = \frac{V_m}{2\sqrt{3}}$$

Full wave rectifier:-

when Sinusoidal signal is applied full-wave rectifier Converts it into pulsating DC by using Centre-tapped transformer. During the first half cycle one of the diode Conducts. During the second half cycle other diode conducts. So full wave is rectified as pulsating DC. In both cycles signal is generated in +ve side only.

$$V_{dc} = V_{avg} = \frac{1}{\pi}\int_0^{\pi} V_m \sin\theta \, d\theta = \frac{2V_m}{\pi}$$

$$V_{AC} = V_{rms} = \sqrt{\frac{1}{\pi}\int_0^{\pi} (V_m \sin\theta)^2 d\theta} = \frac{V_m}{\sqrt{2}}$$

$$V_{r(rms)} = \sqrt{(V_{rms})^2 - (V_{dc})^2}$$

$$\text{ripple factor} = \frac{V_{r(rms)}}{V_{dc}} \times 100\%$$

with Capacitor filter $V_{dc} = V_m - \frac{V_p}{2}$

$$V_{ac} = \frac{V_m}{4\sqrt{3}}$$

$$\text{Voltage regulation} = \frac{V_{NL} - V_{FL}}{V_{FL}} \times 100\%$$

Bridge - Rectifier:-

In this rectifier there are four diodes. The main difference between bridge and centre tapped rectifier is, the given input voltage divides equally. So we will get magnitude, then we get in bridge rectifier how-much we applied as input.

procedure:-

Half-wave rectifier:-

1) Generator a signal by using functional generator with maximum amplitude and set the input voltage Vin.

2). Apply the V_{in} to the diode and resistor Circuit from that we get V_m then Calculate V_{rms}, V_{dc}, $V_{r(rms)}$, and R_f.

3) Introduce a filter to the Circuit and observe the wave forms on CRO Screen, find $V_{r(p-p)}$, $V_{r(rms)}$, V_{dc}, measuring voltage at the output terminal when load isn't Connected

4) Introduce two different loads on the Network and find the load voltage V_{FL} at the output.

5) Apply this voltage to zener diode and observe output on Screen.

Full wave and Bridge wave rectifier:-

1) Check the AC adapted in CRO through connecting patch cords. Check whether two half's of centre-tapped rectifiers are giving output (or) not.

2) For full wave rectification first note down the input voltage V_{in}. Connect the circuit

3) Find ~~full~~ V_m, V_{rms}, V_{dc}, Ripple factor for full wave and Bridge wave rectifier

4) By introducing capacitor in parallel in parallel with resistors keep the output voltage in DC mode and V_m, V_{pp}, V_{dc} is calculated

5) Then the connection of the another resistance in parallel to the capacitors. Find out the voltage across it. and also voltage regulation

6) Observe the waveform by containing Zener diode & Ic regulation.

Precautions:-

1) Make sure that the connections are correct and tight.

2) In rectifier T_3 is not connected to ground.

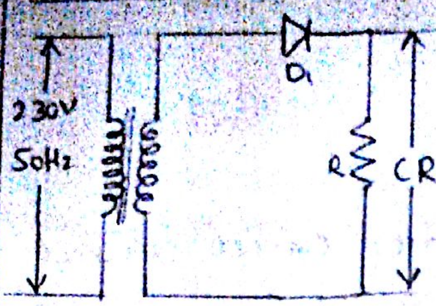
3) Calculate the ranges of electrical Components currently.

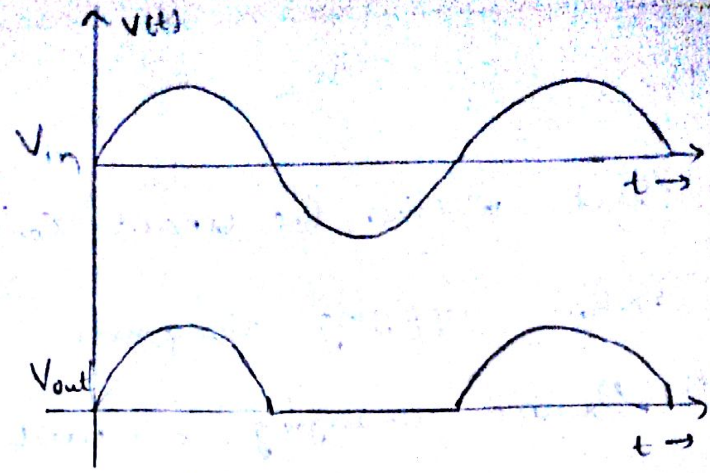
4) Make the Connections on kit properly. Otherwise it will damage

5) Before changing the Circuit turn off the power supply.

Result:- Half-wave rectification & full-wave rectification is Completed using filters & Values are noted down.

Half-wave Rectifier:-





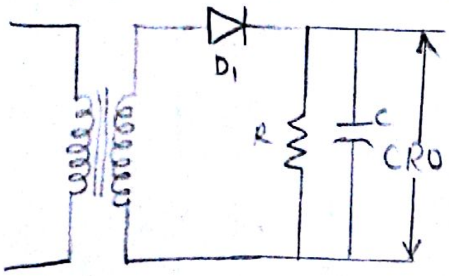
$V_m = 1.9\ V$

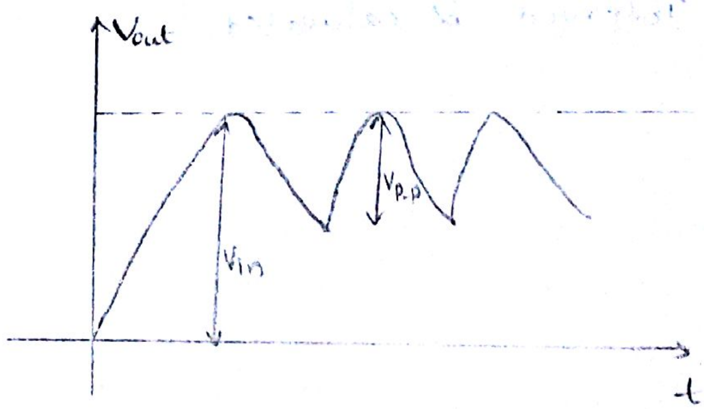
$V_{dc} = \frac{V_m}{\pi} = \frac{1.9}{3.14} = 0.605\ V$

$V_{rms} = \frac{V_m}{2} = \frac{1.9}{2} = 0.95\ V$

$V_{r(rms)} = \sqrt{(V_{rms})^2 - (V_{dc})^2} = \sqrt{(0.95)^2 - (0.605)^2} = 0.7324\ V$

Ripple factor $= \frac{V_{r(rms)}}{V_{dc}} \times 100 = \frac{0.7324}{0.605} \times 100 = 121\%$





$C = 10\mu F$, $R = 330\Omega$

$V_m = 3.5\ V$

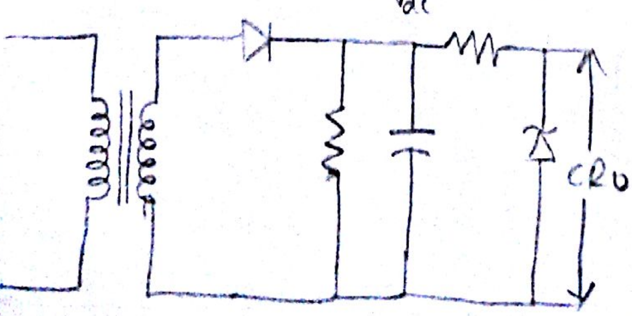
$V_{p\text{-}p} = 2.5\ V$

$V_{dc} = V_m - \frac{V_{pp}}{2} = 3.5 - \frac{2.5}{2} = 2.25\ V$

$V_{rms} = \frac{V_m}{2} = \frac{3.5}{2} = 1.75$

$V_{r(rms)} = \frac{V_{rms}}{2\sqrt{3}} = \frac{1.75}{2\sqrt{3}} = 0.5052$

ripple factor (R) $= \frac{V_{r(rms)}}{V_{dc}} \times 100 = \frac{0.5052}{2.25} \times 100 = 22.4\%$

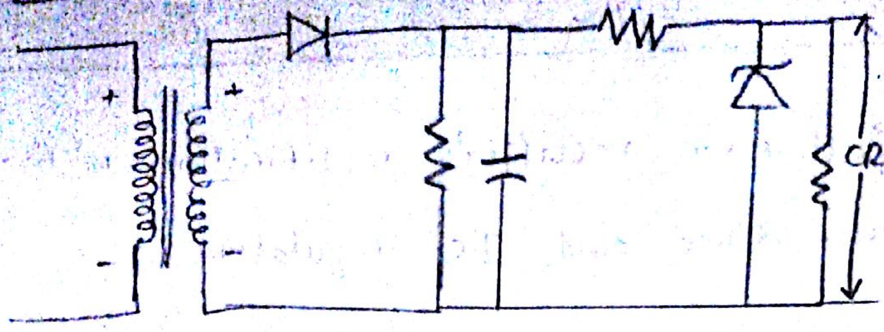


Across Zener diode:-

$V_m = 3.4$, $V_{p\text{-}p} = 2.7$

$V_{dc} = V_m - \frac{V_{pp}}{2} = 3.4 - \frac{2.7}{2} = 2.05\ V$

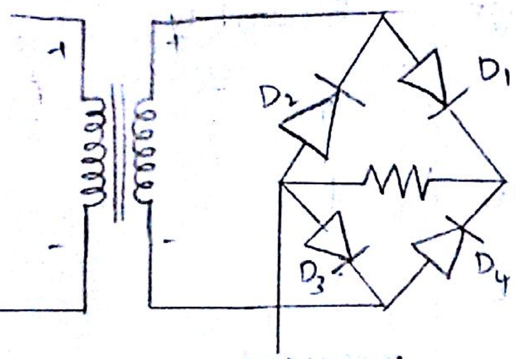
HWR with Full load:-

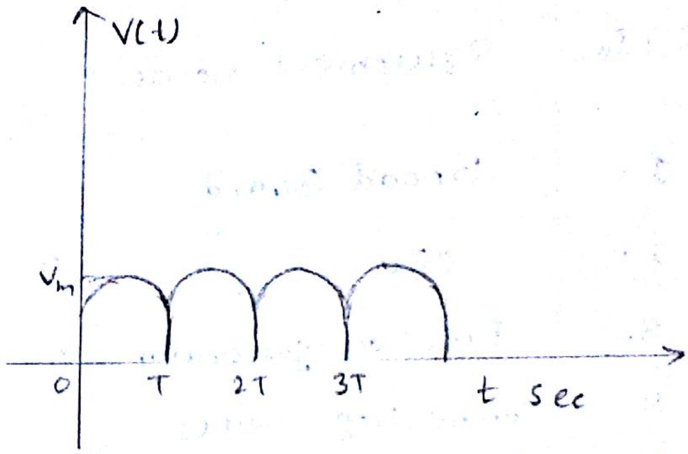


$$\text{voltage regulation } (\%) = \frac{V_{dc}(NL) - V_{dc}(FL)}{V_{dc}(FL)} \times 100 = \frac{2.25 - 2.05}{2.05} \times 100$$

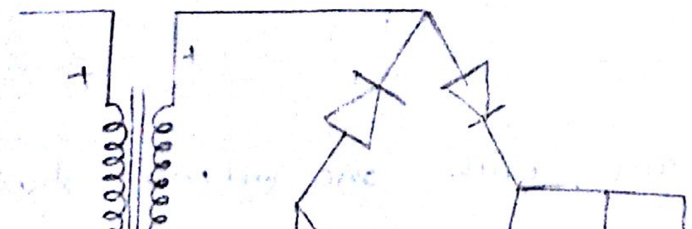
$$= 9\%$$

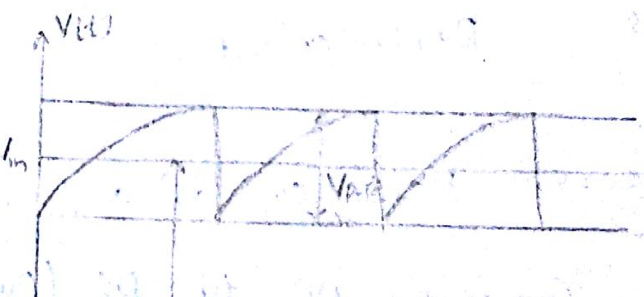
Bridge Rectifier:-



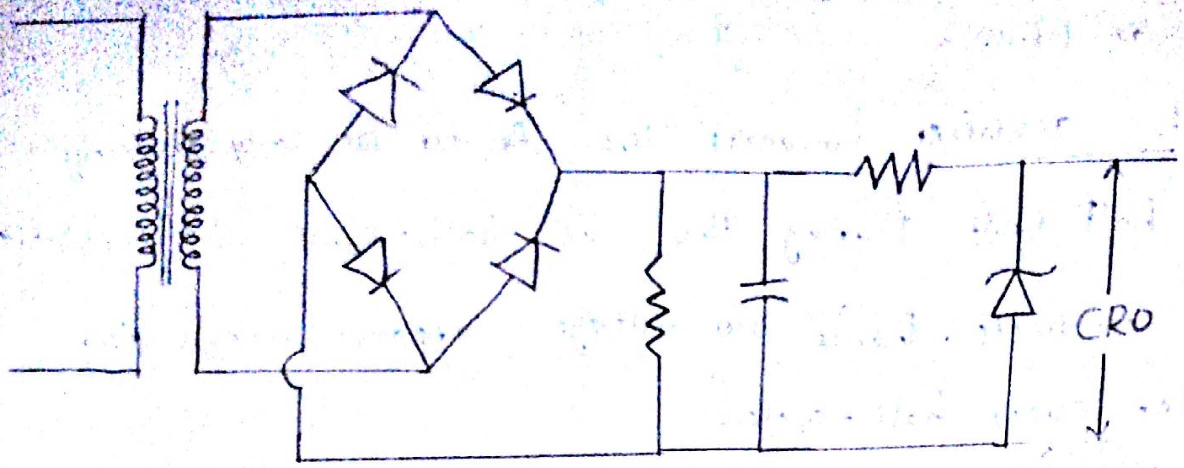


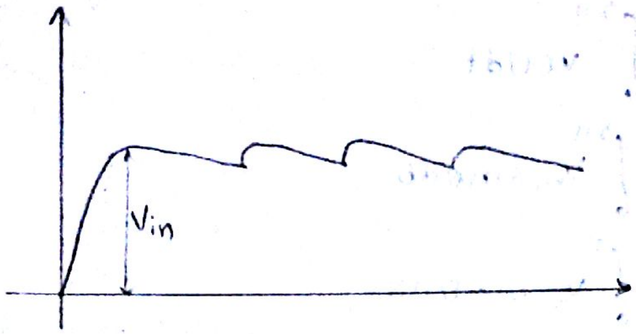
Bridge Rectifier with filter:-



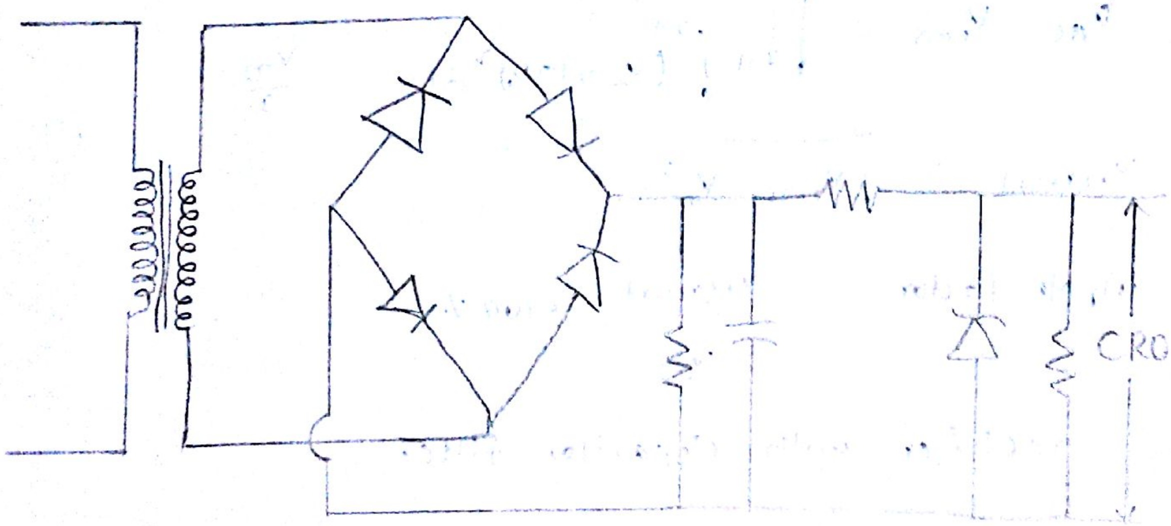


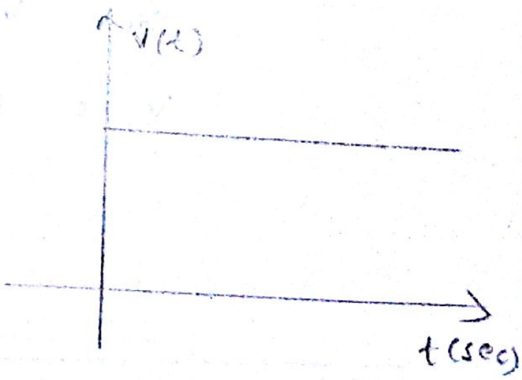
Bridge Rectifier with filter & Zener diode:-





Bridge rectifier with Full load :-





Bridge rectifier calculations

Across Resistor:

$V_m = 7.2V$

$V_{rms} = \frac{V_m}{\sqrt{2}} = \frac{7.2}{\sqrt{2}} = 5.0912V$

$V_{dc} = \frac{2V_m}{\pi} = \frac{2\times7.2}{3.14} = 4.585V$

$V_{r(rms)} = \sqrt{V_{rms}^2 - V_{dc}^2} = \sqrt{(5.0912)^2 - (4.585)^2} = 2.21V$

Ripple factor $= \frac{V_{r(rms)}}{V_{dc}}\times100 = \frac{2.21}{4.585}\times100 = 48.2\%$

Across capacitor:-

$V_m = 7.2V$

$V_{p\text{-}p} = 0.6V$

$V_{dc} = V_m - \frac{V_{pp}}{2} = 6.9V$

$V_{r(rms)} = \frac{V_m}{4\sqrt{3}} = 1.039V$

Across zener diode:-

$V_m = 3.8V$ $V_{pp} = 0.4V$

$V_{dc} = 3.6V$ $V_{rms} = 1.645V$

Across load:-

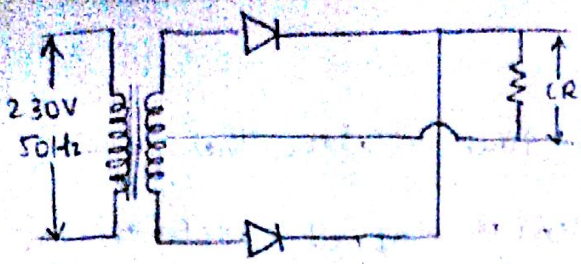
$V_m = 6.8V$

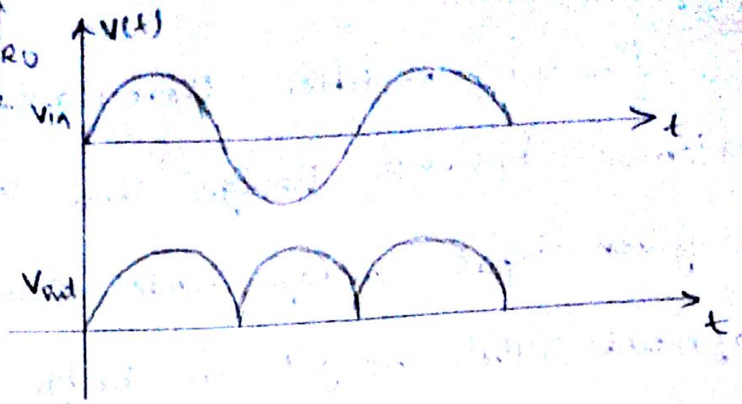
$V_{pp} = 4.4V$

$V_{dc} = 4.6V$

voltage regulation:- $\frac{6.9-4.6}{4.6}\times100 = 50\%$

Full wave rectifier (Center Tapped):—





Across Resistor

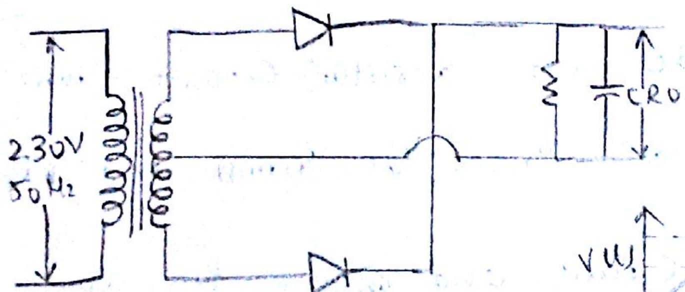
$V_m = 8V$

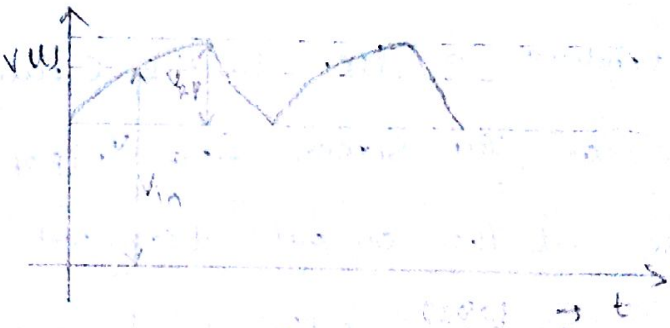
$V_{dc} = \frac{2V_m}{\pi} = \frac{16}{\pi} = 5.09V$

$V_{rms} = \frac{V_m}{\sqrt{2}} = 5.65V$

$V_{r(rms)} = \sqrt{V_{rms}^2 - V_{dc}^2} = \sqrt{(5.65)^2 - (5.09)^2} = 2.45V$

Ripple factor (R.F.) $= \frac{V_{r(rms)}}{V_{dc}} \times 100 = \frac{2.452}{5.09} \times 100 = 48.15\%$





Across Capacitor:—

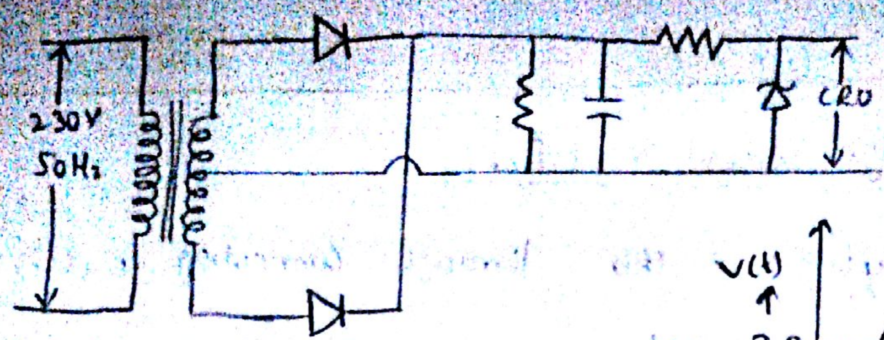
$V_{p-p} = 0.4 \times 2 = 0.8V$

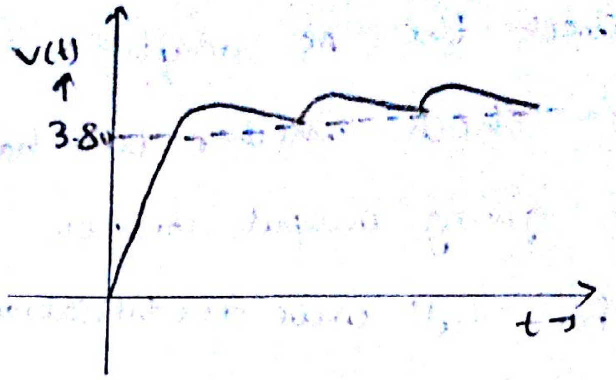
$V_m = 3.8 \times 2 = 7.6V$

$V_{dc} = V_m - \frac{V_{p-p}}{2} = 7.6 - \frac{0.8}{2} = 7.2V$

$V_{r(rms)} = \frac{V_m}{4\sqrt{3}} = 1.09V$

Ripple factor $= \frac{V_{r(rms)}}{V_{dc}} \times 100 = \frac{1.09}{7.2} \times 100 = 15.1\%$



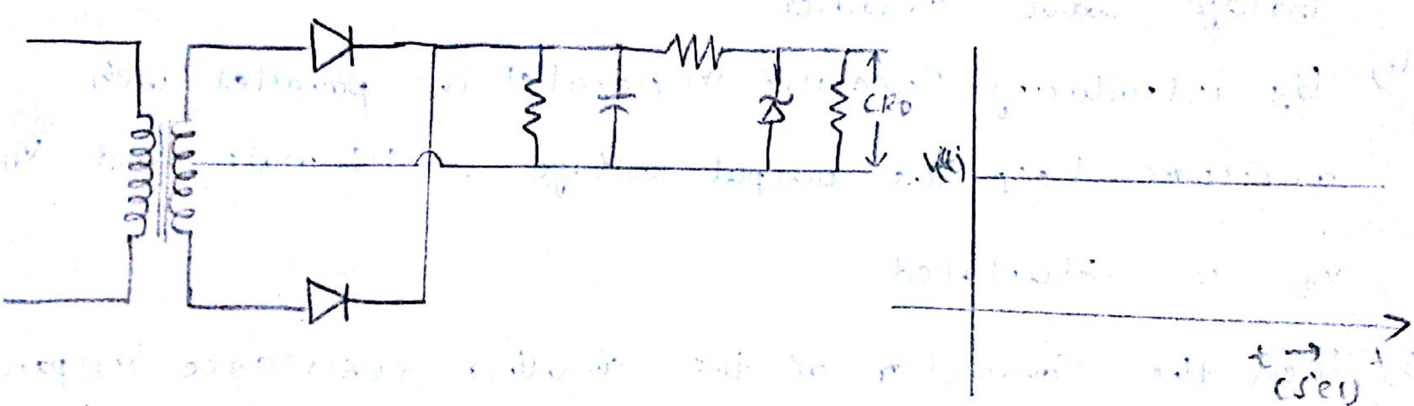


$V_m = 3.8V \quad V_{p-p} = 0.3V$

$V_{dc} = 3.8 - \frac{0.3}{2} = 3.65\ V$

$V_{rms} = \frac{V_m}{4\sqrt{3}} = 0.548\ V$

$V_{No\,load} = V_m = 7.2\ V$



$V_{Full\,load} = V_{dc} = 7.2 - \frac{4.6}{2} = 4.9\ V$

$$\%\text{ of regulation} = \frac{V_{No\,load} - V_{Full\,load}}{V_{Full\,load}} \times 100$$

$$= \frac{7.2 - 4.9}{4.9} \times 100 = 46.9\%$$

Date: 15-10-2014
Experiment No.: 5

Page No.: 23
ID No.:

5. Studies on Logic gates

Aim:- To study the various experiments with NAND, AND, OR, NOR, EXOR & X-NOR gates.

Apparatus required:-

S.No.	Name of the Component	Range	Quantity
1.	DRPS	0-5V	1
2.	Bread board		1
3.	Connecting wires		required
4.	Ic		1
	7400 - NAND		1
	7402 - NOR		1
	7408 - AND		1
	7432 - OR		1
	7486 - XOR		1
	7404 - NOT		1
	7402 - XNOR		1
5.	Logic gate kit		1

Theory:- Logic gates are two types

1) Basic gates:- OR, AND, NOT

2) Universal gates:- NAND, NOR

Logic Gates are gates which does logical functional operation. A large number of electronic circuits are made up of logic gates. These process signals which represents true (or) False. There are two types of logic gates

i) Universal gates

ii) Basic gates

→ Truth Tables are used to show logic gate functions.

→ Some special gates are there like E-XOR, EX-NOR.

X-OR :- (Exclusive OR Gate):

The X-OR gate is a Circuit which gives a high output either but not both of its inputs are high.

X-NOR :-

The X-NOR gate is oppositive the X-OR gate.

procedure :-

logic binary digit 1 = 5v (Vcc) supply

logic binary digit 0 = 0v (Vcc) ground.

1) Connect the Circuit and place 5v supply wire and ground wire on kit in their respective socket.

2) give 0&0 are inputs observe the high Condition on this Case L.E.O is in OFF condition indicates the binary digits

3) give 1&0 as input and observe that light is off Condition.

4) Now give 0&1 as input and observe the light is off Condition

5) give 1&1 as input and observe that light is in on Condition. it ~~condition~~ indicates binary digit -1

6) Now we have to realization that we have to get basic gates by using universal logic ~~ga~~ codes.

7) To get AND gate from NAND Connect NAND in Series & Observe the output and Compare with OR and ~~two~~. truth table

8) To get AND gate from NOR gate Connect two NOR, in Series and observe the output and Compare with "OR" gate.

9) AND also varies the law. They are associative, distributive, Commutative, demorgan's law etc.

precautions:-

1) Check whether the Ic's & LED are working (or) not.

2) Ic pins are very dedicate, so handle them with care.

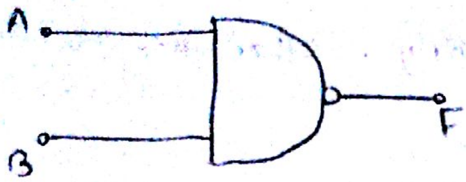
3) Switch off the power after complition of the Experiment.

4) on the bread board Connect the resistance to lead to & avoid burning of lead (LED)

Result:- The gates OR, AND, NOT, NAND, NOR, XOR & truth tables of gates are obtained & Verified.

Universal gates:-

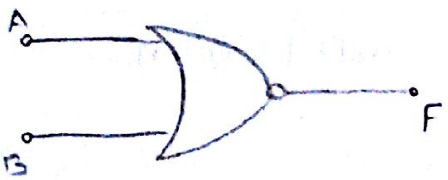
NAND



IC = 7400

A	B	$F = \overline{A \cdot B}$
0	0	1
0	1	1
1	0	1
1	1	0

NOR

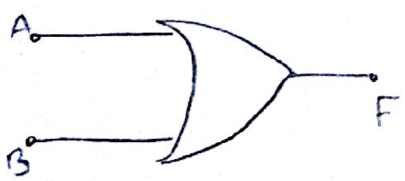


IC = 7402

A	B	$F = \overline{A + B}$
0	0	1
0	1	0
1	0	0
1	1	0

Basic gates:-

OR gate:-



IC = 7432

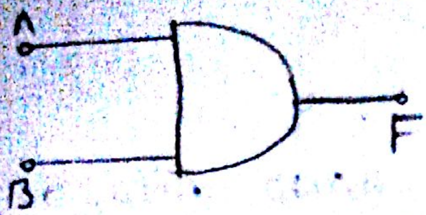
A	B	$F = A + B$
0	0	0
0	1	1
1	0	1
1	1	1

NOT

IC = 7404

A	$F = \bar{A}$
0	1
1	0

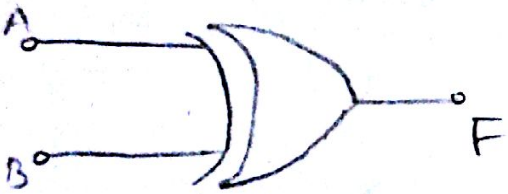
AND



$I_c = 7408$

A	B	$F = A \cdot B$
0	0	0
0	1	0
1	0	0
1	1	1

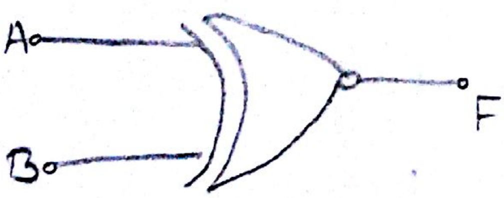
EX-OR



$I_c = 7486$

A	B	$F = A \odot B$
0	0	1
0	1	0
1	0	0
1	1	1

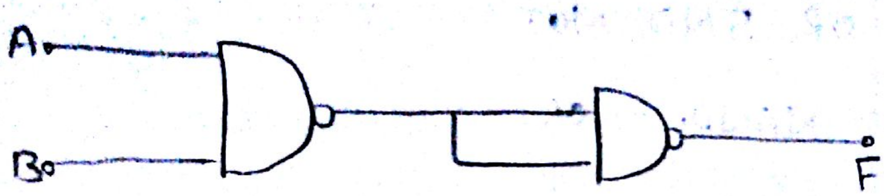
EX-NOR



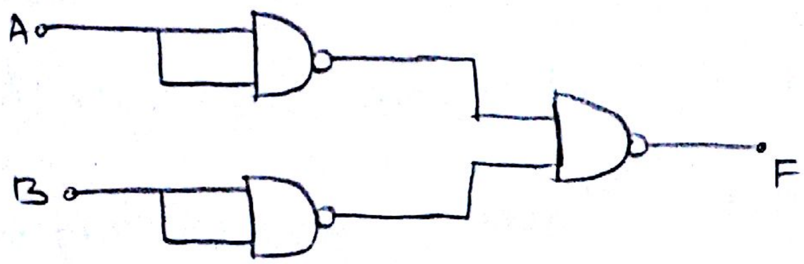
A	B	$F = \overline{A \odot B}$
0	0	0
0	1	1
1	0	1
1	1	0

Realizing Using NAND Gate

1) AND Using NAND

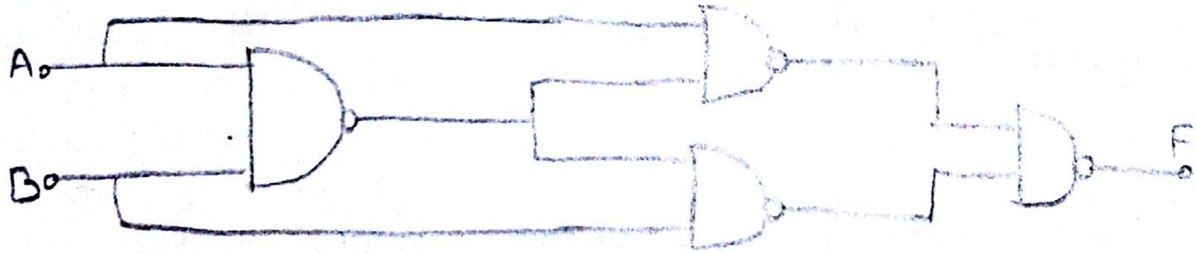


2) OR Using NAND



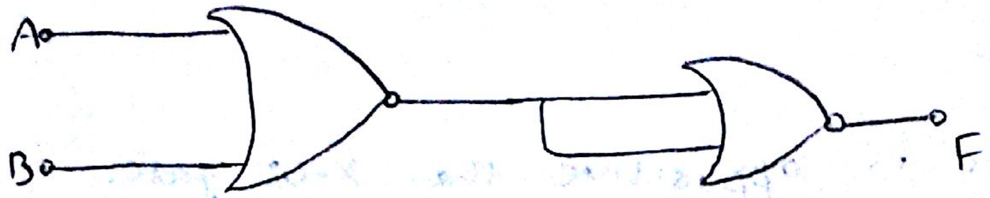
3) NOT Using NAND

4) XOR Using NAND

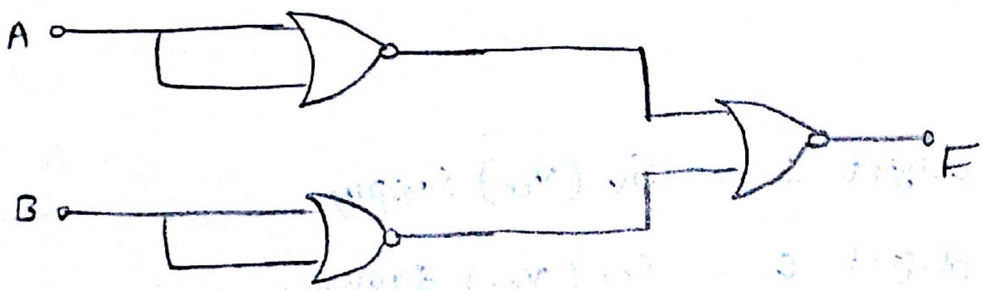


Realizing Using NOR Gate:-

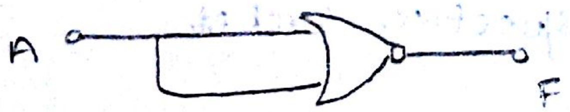
1) OR Using NOR



2) AND Using NOR



3) NOT Using NOR



Studies on CE Amplifier.

Aim:- To study about the Small signal Amplifier

Apparatus required:-

S.No.	Equipment name	Quantity
1.	CE Amplifier kit	1
2.	Function generator	1
3.	Fixed power supply	1
4.	multimeter	1
5.	CRO	1
6.	Connecting wires	required

Theory:- The basic design criteria of transistor biased amplifier circuits starts with the designing of suitable dc bias circuit to fix a dc operating point (Q) on the load line. The designed input of AC signal to be amplifier applied externally. to the input side of the transister in such away that when signal source is removed from the circuit Q-point remains unchanged.

The function of the Capacitor in the Circuit are explained in this manner. Note down that reactance say X_C of any capacitor C is $X_C = \frac{1}{2\pi f c}$ which is a function of frequency. Since the Capacitor behaves as an Circuited Component to the dc signal. thus the capacitor C_1 behaves as an open circuited to dc voltage appearing at the base terminal & protects only flow of dc current from the bias current to the A.C. source side through R_L.

procedure:-

(a) Measurement of DC Analysis:-

1) Supply 12V V_{CC} to the amplifier circuit from the dc power supply.

2) Connect the power supply ground to circuit ground.

3) Measure V_B, V_C, V_E, V_{BE}, V_{CE}, V_{CB}, I_E values by using multimeter. Calculate the I_B, I_C values

4) Determine whether the amplifier is biased in the active region and Q-point is suitably located.

(b) Measurement of signal handling Capacitor :-

1) Connect the Capacitor . 10μF Coupling , 100 μF by pass Capacitor in Circuit

2) Apply a mild band frequency (4 kHz) sinusoidal voltage of about 100m V_{pp} amplitude V_{in} & observe the output waveform of CRO.

3) Increase the input voltage in steps & measure the Corresponding output voltage & Calculate the gain.

4) Note the maximum input V_{max} for which the gain remain Constant (or) the output waveform get disturbed.

5) This is signal handling Capacity.

6) Now Connect the load R_L in the Circuit

7) After Connecting the load again. Find out V_{max}.

8) Compare this results with the $V_{s\,max}$ Value without the load.

(c) Measurement of frequency responce :-

1) Connect the 100μF capacitor across R_E resistor in the circuit.

2) Keep the V_{in} Should be less than $V_{s\,max}$.

3) Take the readings by varying frequency with load and without load and tabulate the V_{out} values and note at which frequency V_{out} becomes Constant and at which frequency it starts decreasing.

4) Then remove ~~CE~~ C_E capacitor by varying the frequency taking the readings with load and without load. And tabulate the values, observe that at which frequency out becomes Constant and which frequency it starts decreasing.

5) Plot the frequency responce of amplifier graph i.e. $20 \log\left(\frac{V_o}{V_{in}}\right)$, Vs frequency. from the plot determine the lower & upper cut off frequency.

6) Those are the frequency at which the ratio $20 \log\left(\frac{V_o}{V_{in}}\right)$ falls 3 dB below its maximum values.

Observations:-

1) gain changes for different frequency signals

2) gain is maximum for medium frequency.

3) The gain is more when the CE is connected in parallel with emitter resistance.

4) gain is maximum when load is maximum.

Precautions:-

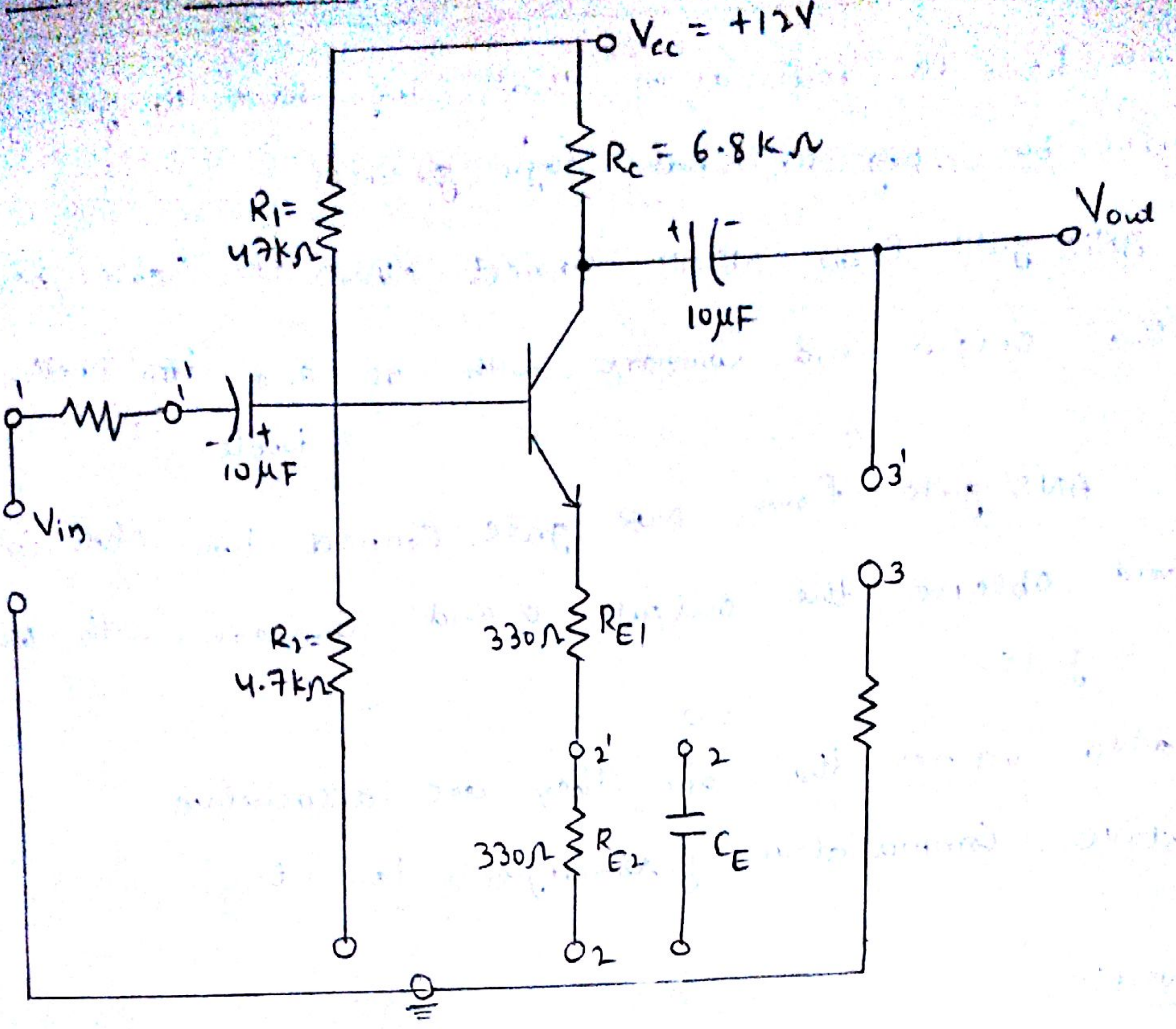
1) Take more frequency values when the gain is suddenly changing.

2) check the output voltage ~~amplifier~~ amplitude before applying to circuit, for the frequency responce input voltage less than V_{sm}.

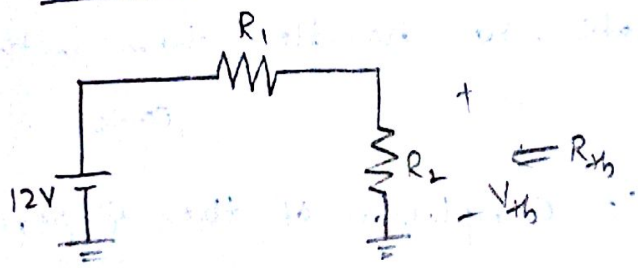
Result:-

Studies on DC biasing, signal handling capacity & frequency Response of CE amplifier is done.

Circuit Diagram:-



DC - Analysis:-



$R_{th} = R_1 || R_2$

$= \frac{47 \times 4.7}{51.7} = 4.272\,k\Omega$

$V_{th} = V_{R_2} = \frac{4.7}{51.7} \times 12 = 1.09V$

KVL to i/p LOOP (BE)

$V_{th} - I_B R_{th} - V_{BE} - I_E R_E = 0$

$I_c \approx I_c = \beta I_B$

$\Rightarrow V_{Th} - I_B R_{Th} - V_{BE} - \beta I_B R_E = 0$

$$I_B = \frac{V_{Th} - V_{BE}}{R_{Th} + \beta R_E} = \frac{1.09 - 0.7}{4.272 + (150 + 660)}$$

$$= \frac{0.39}{103272} = 3.776 \mu A$$

$I_c = \beta I_B = 150 \times 3.776 \mu A = 0.556 mA$

$I_E = (\beta + 1) I_B = 0.570 mA$

KVL to o/p loop (CE)

$V_{cc} - I_c R_c - V_{CE} - I_E R_E = 0$

$V_{CE} = V_{cc} - I_c R_c - I_E R_E$

$= 12 - 0.566 \times 6.8 - (0.570 mA)(660)$

$= 12 - 3.848 - 0.376$

$= 7.776\ V$

$V_c = 12 - I_c R_c = 12 - 3.848 = 8.152 V$

$V_{CE} = V_c - V_E \Rightarrow V_E = V_c - V_{CE}$

$= 8.152 - 7.776 = 0.376 V$

$V_B = V_{BE} + V_E = 0.7 + 0.376 = 1.076 V$

Practical Values:-

$V_B = 1.05 V$, $V_E = 0.45 V$ $V_c = 4.55 V$ $V_{CE} = 6.8 V$

$V_{BE} = 0.6 V$; $R_c = 6.8 k\Omega$, $R_B = 4.7 k\Omega$ $R_E = 660 \Omega$

$$I_c = \frac{V_c}{R_c} = \frac{4.55}{6.8 k\Omega} = 0.669 mA$$

$I_E = \frac{V_E}{R_E} = \frac{0.45}{660\Omega} = 0.681\, mA$

$I_B = I_E - I_C = 0.681 - 0.669$

$= 0.012 mA = 12 \mu A$

$\beta = \frac{I_C}{I_B} = \frac{0.669 mA}{12 \mu A} = 557$

Signal Handling Capacity :-

$f = 4 kHz$

S.No.	V_{in} (V)	V_{out}	
		with R_L	without R_L
1.	100mV	120mV	0.88V
2.	200mV	240mV	1.9V
3.	300mV	350mV	2.7V
4.	400mV	480mV	3.7V
5.	500mV	600mV	4.5V
6.	600mV	750mV	5.4V
7.	700mV	800mV	6V
8.	800mV	1V	6.8V
9.	900mV	0.92V	7.2V
10.	1V	0.9V	6.8V
11.	1.1V	1V	7.2V
12.	1.2V	1.1V	7V
13.	1.3V	1.2V	7V
14.	1.4V	1.2V	7V
15.	1.5V	1.3V	7.2V

$V_{sm} = 700 mV$

Design of a circuit:-

$V_{cc} = 12V$, $V_{CEQ} = \frac{V_{cc}}{2} = 6V$ $I_{CQ} = 5mA$

$V_E = \frac{V_{cc}}{10} = 1.2V$

Standard Formulas:-

$R_1 = 5R_2$; $R_2 < 0.1\beta R_E$, $C_{c_1} >> \frac{1}{2\pi f R_c}$

$X_{cc_1} << R_2$, $X_E << R_E$, $C_E >> \frac{1}{2\pi f R_E}$

$C_c >> \frac{1}{2\pi f R_L}$

$\beta = 386$

$V_{CE} = V_C - V_E \Rightarrow V_C = 6 + 1.2 = 7.2V$

$V_{BE} \geq 0.7 \Rightarrow V_B - V_E \geq 0.7$

$\Rightarrow V_B \geq 0.7 + 1.2$

$\geq 1.9V$

$V_B = \frac{R_2}{R_1 + R_2} \times V_{cc} = \frac{R_2}{6R_2} \times 12 = 2V$

$I_C R_C = V_{cc} - V_C$

$\Rightarrow R_C = \frac{V_{cc} - V_C}{I_C} = \frac{12 - 7.2}{5mA} = 0.96 k\Omega$

$I_E = \frac{I_C}{\alpha} = 5.01 mA$

$\alpha = \frac{\beta}{\beta+1} = 0.997$

$R_E = \frac{V_E}{I_E} = \frac{1.2}{5.01mA} = 0.239 k\Omega$

$R_2 << 0.1 \times 390 \times 0.239 = 932 \Omega$

$R_1 = 5 \times 0.61k = 3.05 k\Omega$

$C_{c_1} >> \frac{1}{2\pi \times 5k \times 0.96k\Omega} = 0.033 \mu F$

$C_{c_1} >> \frac{1}{2\pi \times 5k \times 0.239 k\Omega} = 0.133 \mu F$

Frequency Response :-

$V_{in} = 0.3V$ gain $= 20 \log \frac{V_o}{V_{in}}$ (dB)

S.No	Frequency (Hz)	V_{out} with R_L (V) with C_E	gain	without C_E	gain
1.	10Hz	0.5	4.4369	0.4	2.4987
2.	20	0.6	6.0205	0.5	4.4369
3.	30	0.7	7.3595	0.5	4.4369
4.	50	0.7	7.3595	0.5	4.4369
5.	100	0.7	7.3595	0.5	4.4369
6.	500	0.7	7.3595	0.5	4.4369
7.	1K	0.7	7.3595	0.5	4.4369
8.	5K	0.7	7.3595	0.5	4.4369
9.	10k	0.7	7.3595	0.5	4.4369
10.	20k	0.7	7.3595	0.5	4.4369
11.	50k	0.7	7.3595	0.5	4.4369
12.	100k	0.7	7.3595	0.5	4.4369
13.	250k	0.7	7.3595	0.5	4.4369
14.	300k	0.7	7.3595	0.5	4.4369
15.	700k	0.7	7.3595	0.5	4.4369
16.	900k	0.7	7.3595	0.5	4.4369
17.	1M	0.7	7.3595	0.5	4.4369
18.	1.5M	0.6	6.0205	0.4	2.4987
19.	2M	0.5	4.4369	0.3	0
20.	2.5M	0.4	2.4987	0.3	0
21.	3M	0.3	0	0.2	-3.5218

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S.No.	Frequency (Hz)	V_{out} without R_L			
		with C_E	gain	without C_E	gain
1.	10	3.6	21.5836	2.6	18.757
2.	20	4.6	23.7127	2.7	19.084
3.	30	4.8	24.0823	2.8	19.400
4.	50	5	24.436	2.8	19.400
5.	100	5	24.43	2.8	19.400
6.	500	5	24.43	2.8	19.400
7	1k	5	24.43	2.8	19.400
8.	5K	5	24.43	2.8	19.400
9.	10k	5	24.43	2.8	19.400
10.	25K	5	24.43	2.8	19.400
11.	50k	5	24.43	2.6	18.757
12.	60k	5	24.43	2.6	18.757
13.	70k	5	24.43	2.5	18.4163
14.	80k	5	24.43	2.4	18.0617
15.	100k	5	24.43	2.3	17.6921
16.	125k	5	24.43	2.2	17.306
17.	150k	5	24.43	2.1	16.901
18.	300k	4	22.449	1.5	13.979
19.	400k	2.8	19.400	1.3	12.736
20.	500k	2	16.478	1.3	12.736
21.	700k	1.6	14.5399	0.9	9.5[illegible]
22.	900k	1.5	13.979	0.8	8.5[illegible]
23.	1M	01	10.4575	0.7	7.359
24.	1.5M	0.8	8.5193	0.5	4.4369
25.	2M	0.7	7.3595	0.4	2.4997
26.	2.5M	0.6	6.0205	0.4	2.498
27.	3M	0.4	2.49877	0.4	2.498