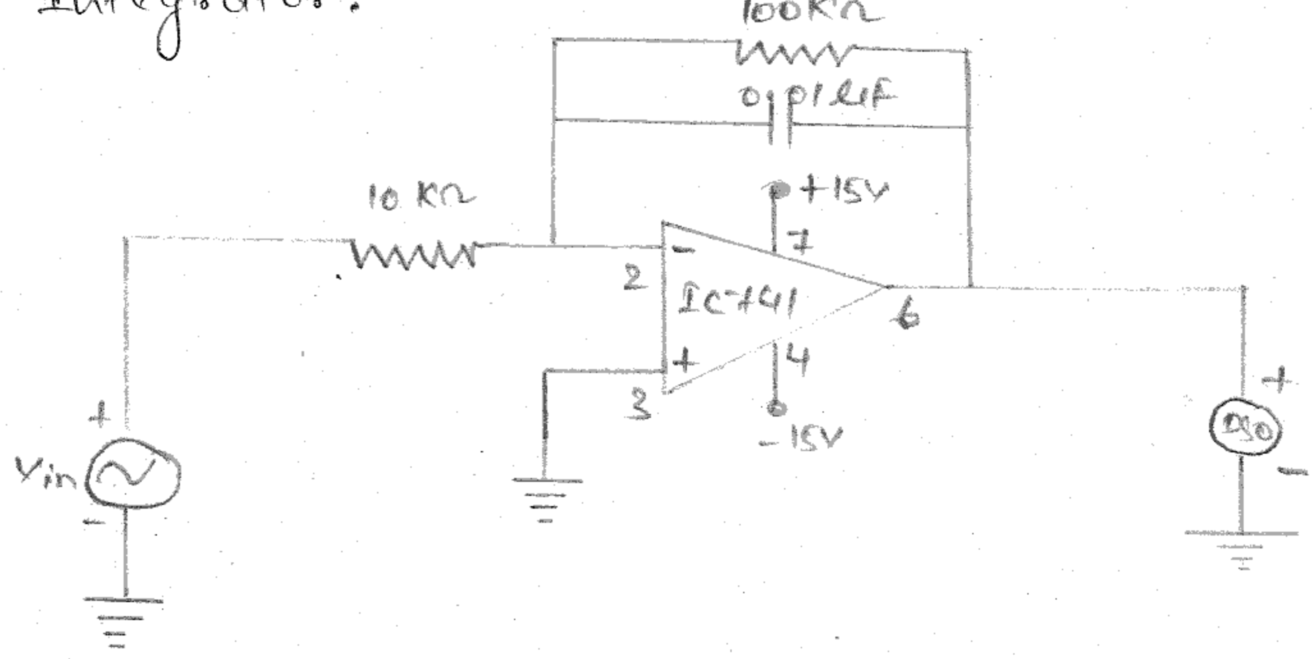
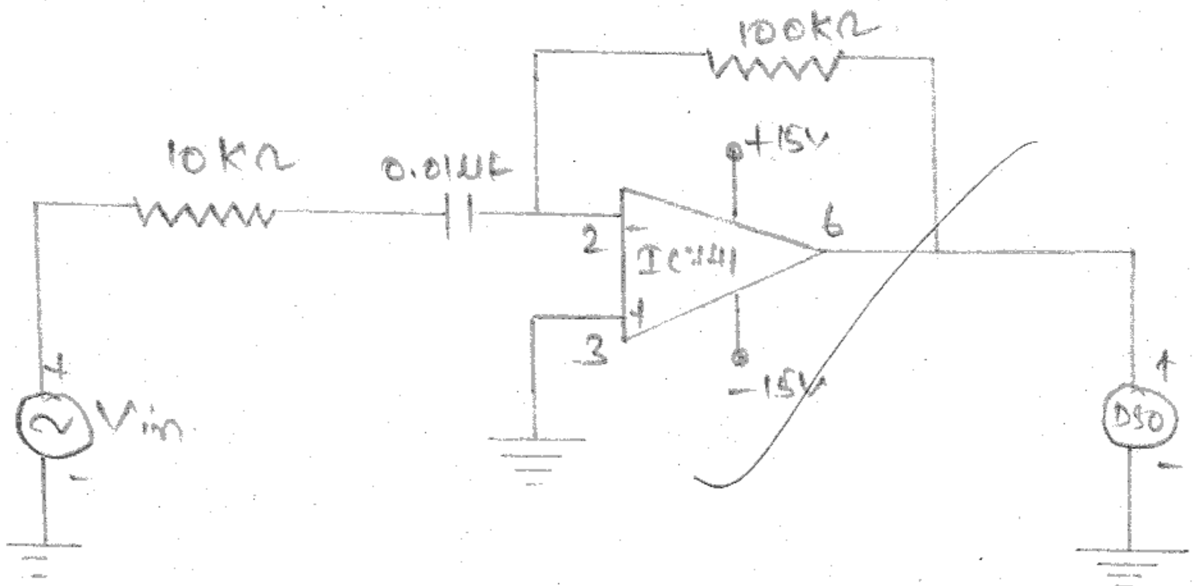
CIRCUIT DIAGRAM

Integrator :-




Differentiator :-



Expt No: 2

Date: 15.07.2011

# INTEGRATOR AND DIFFERENTIATOR USING OP-AMP

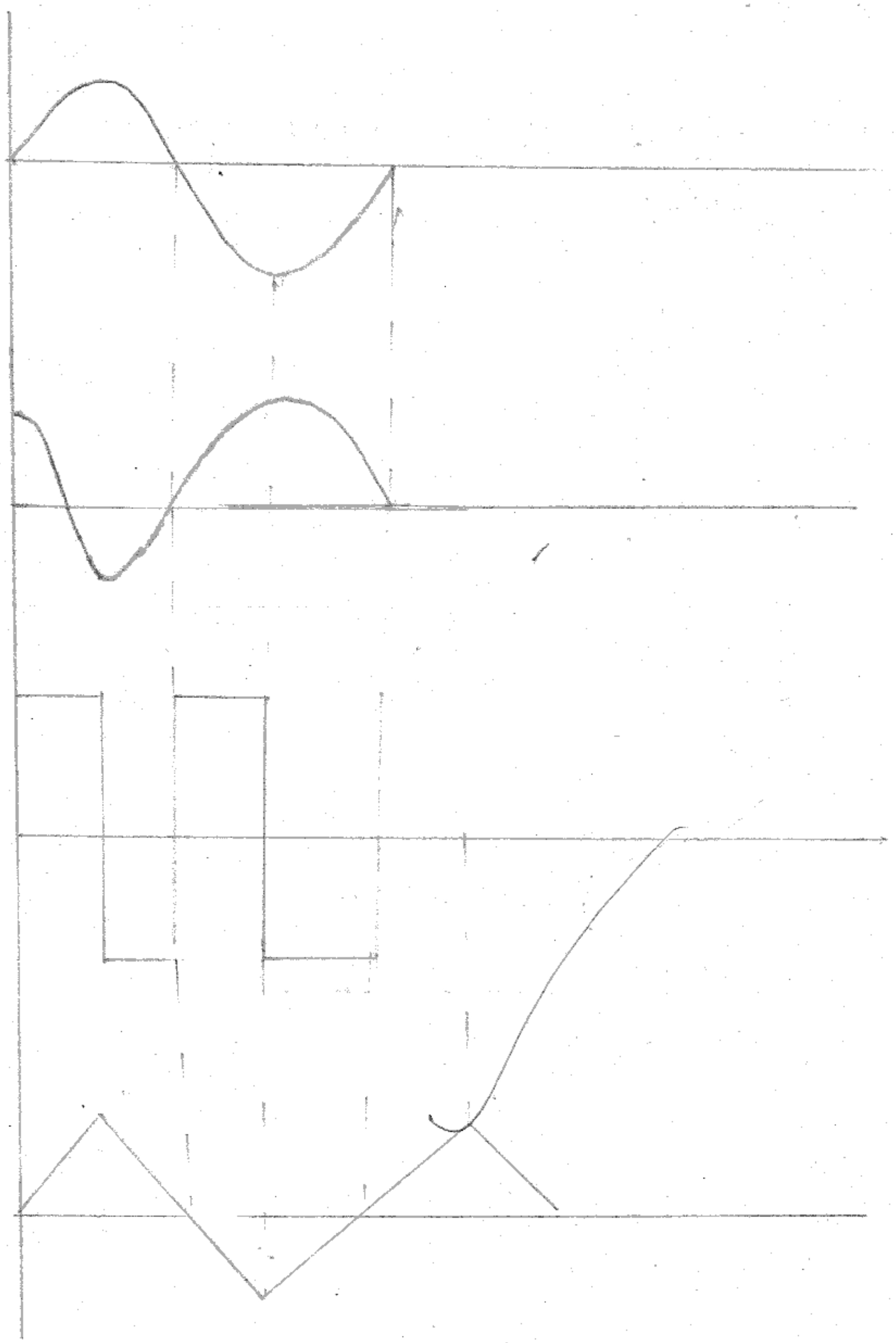
AIM:- To study the operation of integrator and differentiator using operational amplifier

APPARATUS REQUIRED:-

| S.No | Components | Range | Quantity |
|---|---|---|---|
| 1. | IC 741 | — | 1 |
| 2. | Resistor | 10 kΩ | 1 |
| | | 100 kΩ | 1 |
| 3. | Dual power supply | ± 15 V | 1 |
| 4. | Capacitor | 0.01 μF | 1 |
| 5. | Function Generator | — | 1 |
| 6. | DSO | — | 1 |
| 7. | Probes | — | 2 |
| 8. | Connecting wires | — | As reqd. |

MODEL GRPH

Integrator



THEORY :-

INTEGRATED AMPLIFIER :- The Circuit provides an output voltage which is proportional to the time signal of input. Ria is the integrated amplifier

DIFFERENTIATOR :- The differentiator contains capacitor in the simplest circuit of operational amplifier. This circuit performs the mathematical operation of differential [i.e. the output waveform is the derivative of input waveform]

$$V_o = -R_f \left(\frac{C d}{dt}\right)$$

PROCEDURE :-

INTEGRATOR :-

→ Connections are given as per the circuit diagram

→ The sine wave input is given from the function generators.

→ The cosine wave output is obtained because of inverting differentiator

→ The square wave input is given and output is triangular wave.

TABULAR COLUMN

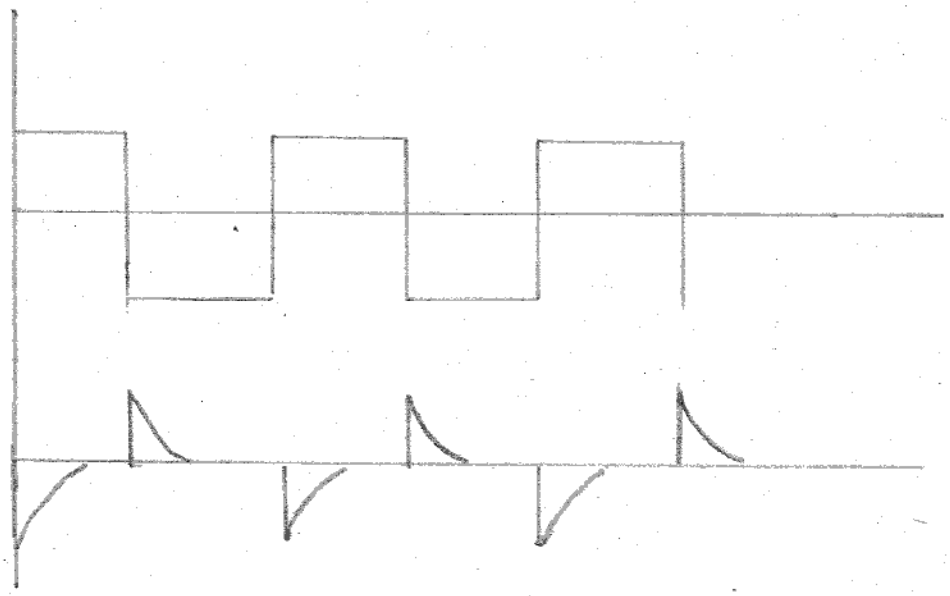
INTEGRATOR

| Waveform | Amplitude (V) | | Time (ms) | |
|---|---|---|---|---|
| | Input | output | Input | output |
| Square wave | 1.58V | 1.98V | 995μs | 995μs |
| Sine wave | 1.18V | 2.93V | 995μs | 995μs |

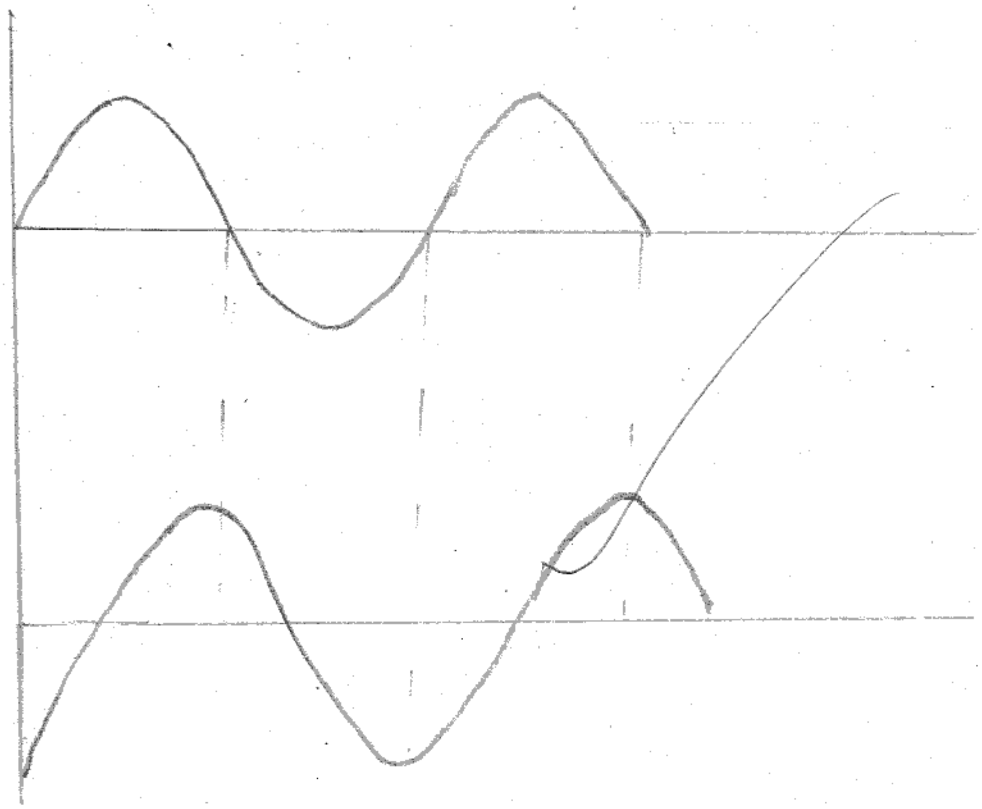
DIFFERENTIATOR:-

| Waveform | Amplitude (V) | | Time Period (ms) | |
|---|---|---|---|---|
| | Input | output | Input | output |
| Sine wave | 1.54V | 7.52V | 1KHz | 995Hz |
| Square wave | 14.7V | 19.01V | 1KHz | 995Hz |

a) Input and output for square wave input



b) Input and Output for sine wave input

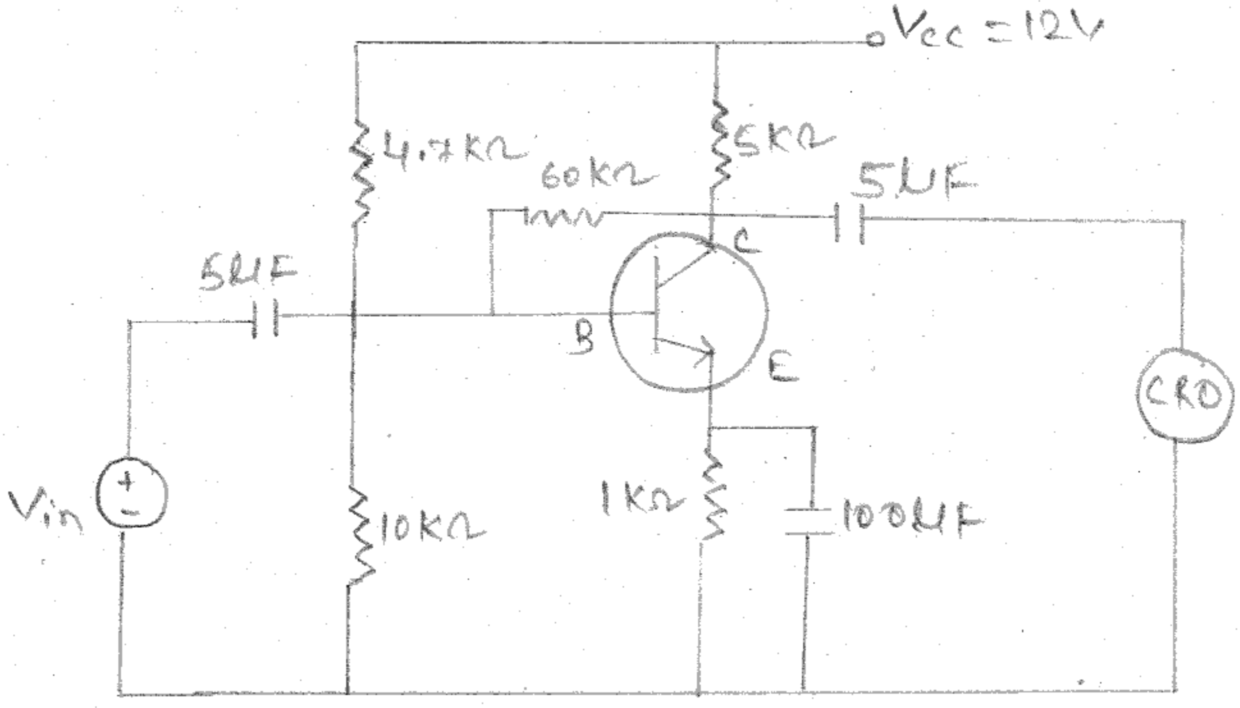


RESULT :-

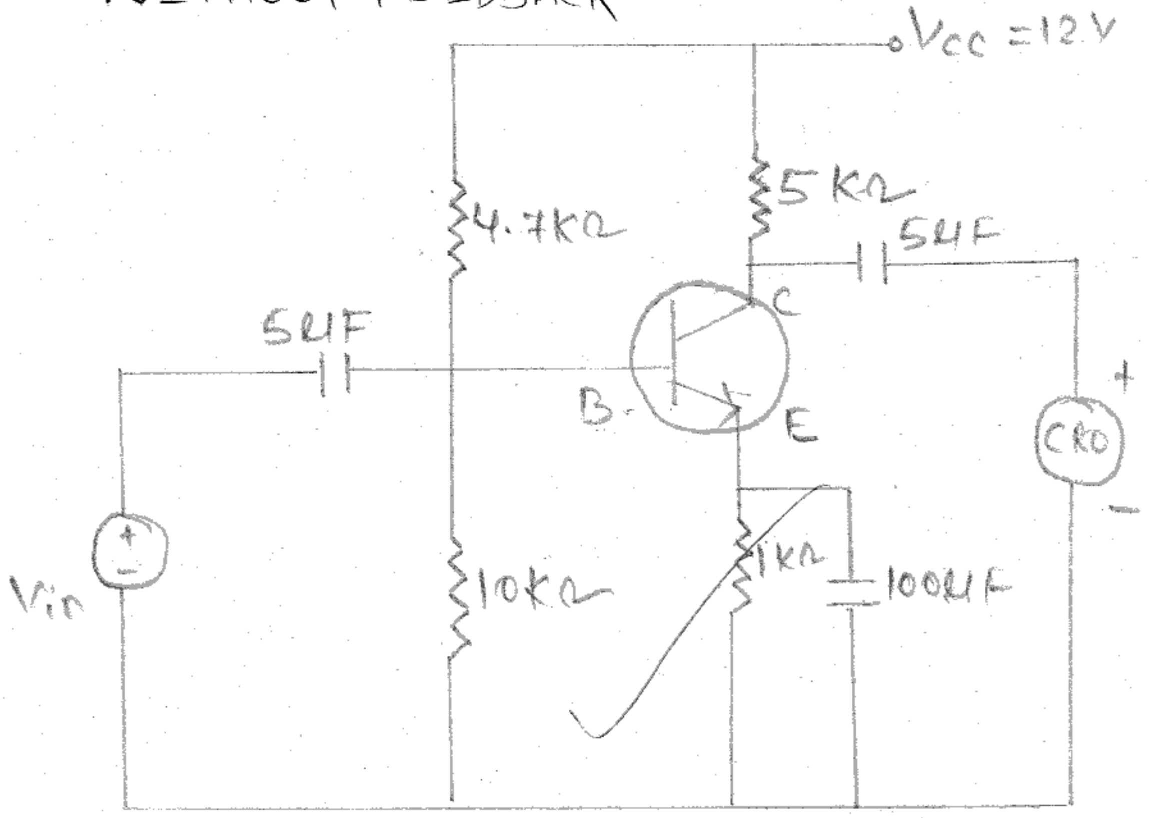
Thus the study of operation of integrator and differentiator using op-amp has been completed.

Circuit Diagram

WITH FEEDBACK




WITHOUT FEEDBACK



EXPT NO : 5

DATE: 15.7.2011

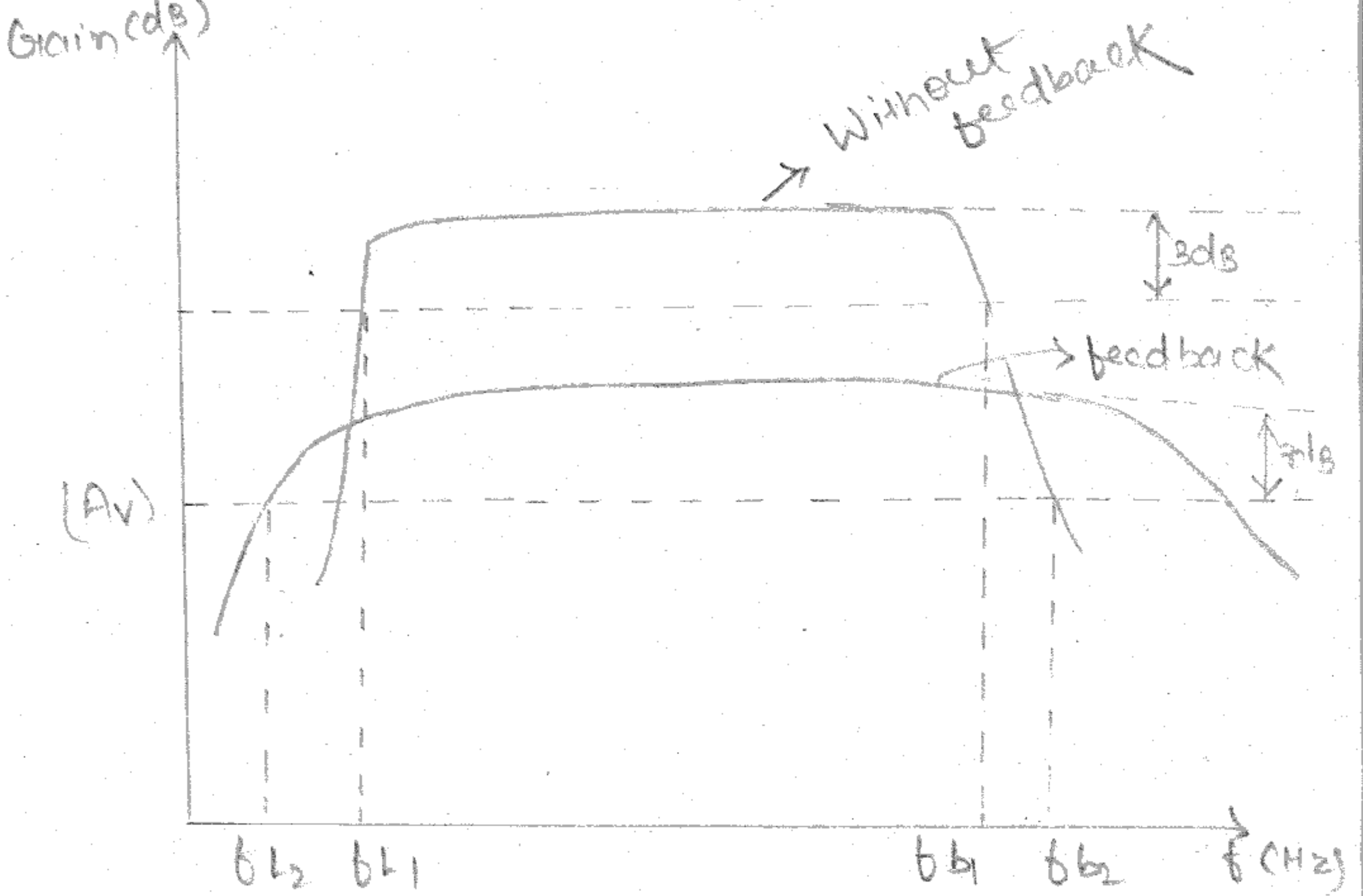
# VOLTAGE SHUNT FEEDBACK AMPLIFIER

AIM:- To design and study frequency response of voltage shunt feedback amplifier

APPARATUS REQUIRED:

| S.No | COMPONENTS | RANGE | QTY. |
|---|---|---|---|
| 1. | Resistor | 4.7 kΩ | 1 |
| | | 5 kΩ | 1 |
| | | 1 kΩ, 10 kΩ | 1, 1 |
| | | 60 kΩ | 1 |
| 2. | Capacitor | 5 μF | 2 |
| | | 100 μF | 1 |
| 3. | Transistor | BC 547 | 1 |
| 4. | DSO | (0-30) MHz | 1 |
| 5. | F.G | (0-30) MHz | 1 |
| 6. | Power Supply | (0-15) V | 1 |
| 7. | Bread Board | — | 1 |
| 8. | Connecting wires | — | As req |

MODEL GRAPH




Design Procedure

$A_{vf} = 100$, $A_v = 250$, $V_{cc} = 12V$, $I_c = 1mA$

(1) Selection of $R_C$ & $R_E$ :-

$V_{cc} = I_c(R_C + R_E) + V_{CE}$ ($V_{CE} = V_{cc}/2$) $= 6V$

$R_E + R_C = \frac{V_{cc} - V_{CE}}{I_c} = \frac{12-6}{10^{-3}} = 6k\Omega$

$V_{RE} = I_c \cdot R_E$

$V_{RE} = 0.1 \; V_{CE} = 0.1 \times 12 = 1.2V$

$R_E = \frac{V_{RE}}{I_c} = \frac{1.2}{1mA} = 1.2k\Omega$

THEORY:-

In a feedback amplifiers the output voltage or current is sampled by means of sampling network and this sampled signal is applied to the input through a two port network. referred as feedback amplifier.

In a shunt feedback a resistor $R_f$ is placed between collector and $R_f$ is placed between collector and base, the feedback signal is proportional to the output voltage $V_o$.

PROCEDURE

1. Connection are given as per the circuit diagram
2. Set $V_{CC} = 10V$, set input voltage using A.f oscillator
3. By varying A.f oscillator take from output frequency oscillator voltage for different frequency.
4. Calculate gain in dB
5. Plot the gain vs frequency curve in semilog sheet.

TABULAR COLUMN

With feedback

| S.No | Frequency (Hz) | $V_o$ (volts) | Gain = $20 \log \frac{V_o}{V_{in}}$ (dB) |
|---|---|---|---|
| 1 | 1 | 1.15 | 1.21 |
| 2 | 1.5 | 1.20 | 1.58 |
| 3 | 2 | 1.25 | 1.93 |
| 4 | 2.5 | 1.50 | 3.52 |
| 5 | 3 | 1.50 | 3.52 |
| 6 | 3.3 | 1.50 | 3.52 |
| 7 | 3.8 | 1.50 | 3.52 |
| 8 | 4.4 | 1.50 | 3.52 |
| 9 | 4.5 | 1.50 | 3.52 |
| 10 | 5 | 1.50 | 3.52 |
| 11 | 5.5 | 1.3 | 2.27 |
| 12 | 6 | 1.26 | 2.00 |
| 13 | 6.5 | 1.25 | 1.21 |
| 14 | 6.7 | 1.13 | 1.06 |

Choose $R_E = 1k\Omega$, $R_i + R_E = 6\Omega$, $R_C = 6 - 1.2 = 4.8 k\Omega$

Choose $R_C = 5 k\Omega$

Selection of $R_1$ and $R_2$

$V_{R2} = V_{BE} + I_E R_E = 0.7 + 1.2 \times 1 = 1.9V$

$V_{R1} = 12 - 1.9 = 10.1 V$

$\frac{V_{R1}}{V_{R2}} = \frac{12}{1.9} = 5.3 = \frac{R_1}{R}$

Assume $R_2 = 10 k\Omega$

WITHOUT FEEDBACK

| S.No | Frequency (Hz) | $V_o$ (volts) | Gain = $20 \log \frac{V_o}{V_{in}}$ |
|---|---|---|---|
| 1. | 150 | 17.03 | 24.62 |
| 2. | 160 | 18.40 | 25.29 |
| 3. | 170 | 19.40 | 25.75 |
| 4. | 175 | 20.20 | 26.10 |
| 5. | 180 | 20.20 | 26.10 |
| 6. | 185 | 20.20 | 26.10 |
| 7. | 190 | 20.20 | 26.10 |
| 8. | 195 | 20.20 | 26.10 |
| 9. | 200 | 20.20 | 26.10 |
| 10. | 210 | 19.8 | 25.93 |
| 11. | 215 | 19.2 | 25.66 |
| 12. | 220 | 18.4 | 25.29 |
| 13 | 230 | 17.3 | 25.00 |

$R_1 = 5.3 \times 10 = 53\,K\Omega$ Choose $R_1 = 47\,K\Omega$

selection capacitance $C_E$

$V_{cc} < 0.1 R_E$

$\frac{1}{2\pi f C_E} \leq 0.1 R_E$

$C_e \geq \frac{1}{2 \times 3.14 \times 10.1 \times 1}$ $C_e \geq 31.81\,\mu F$.

Assume $C_f$ and $C_c = 5\,\mu F$

selection of $R_f$:-

$A_{vf} = -\frac{R_f}{R_S}$ $R_S = 600\,\Omega$

$R_f = R_S \times A_{vf} = 600 \times 100$

$= 60\,K\Omega$

RESULT:-

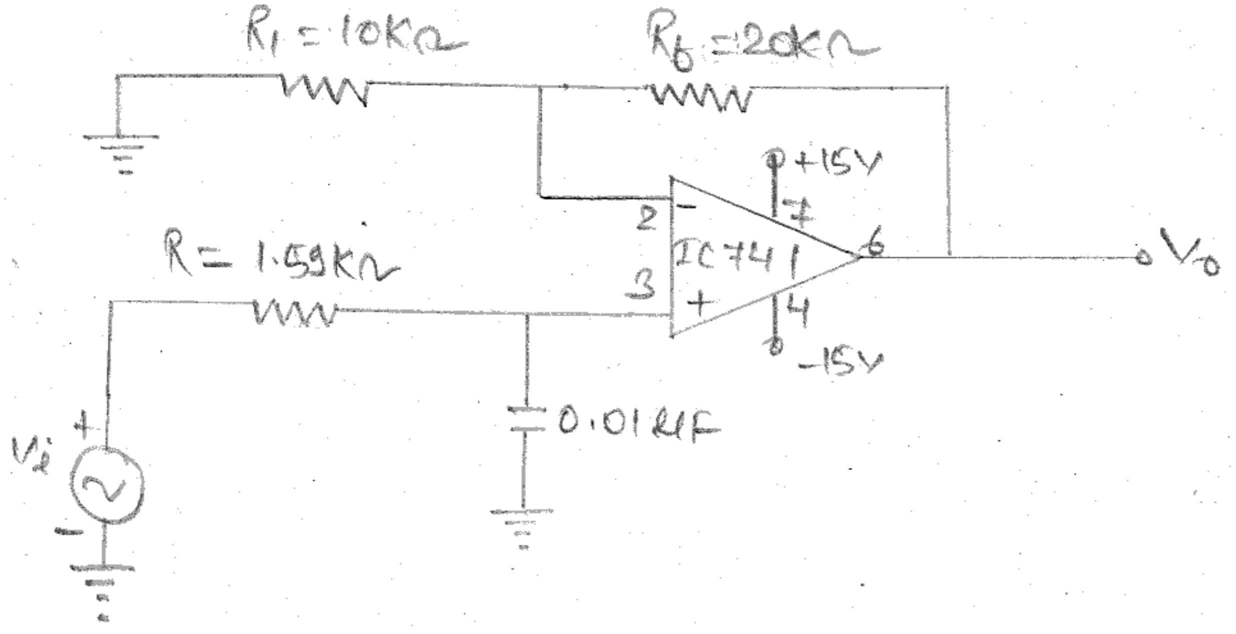
The voltage shunt feedback amplifier is designed and studied its performance

B.W without feedback = 3.8KHZ

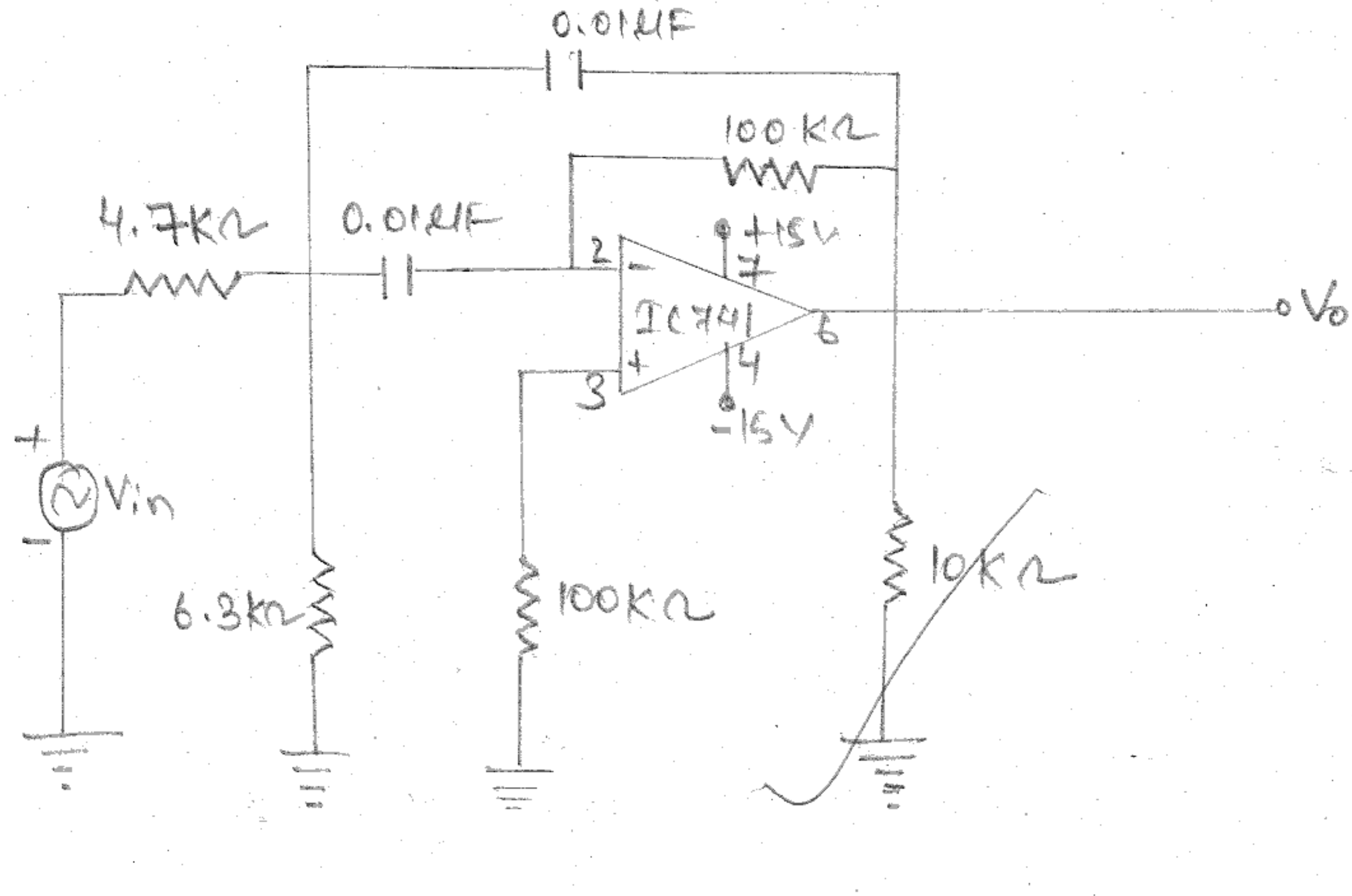
B.W with feedback = 5.6KHZ

Circuit diagram:-

LOW PASS FILTER:-




BAND PASS FILTER:-



Exp No - 6

DATE - 22.7.2011

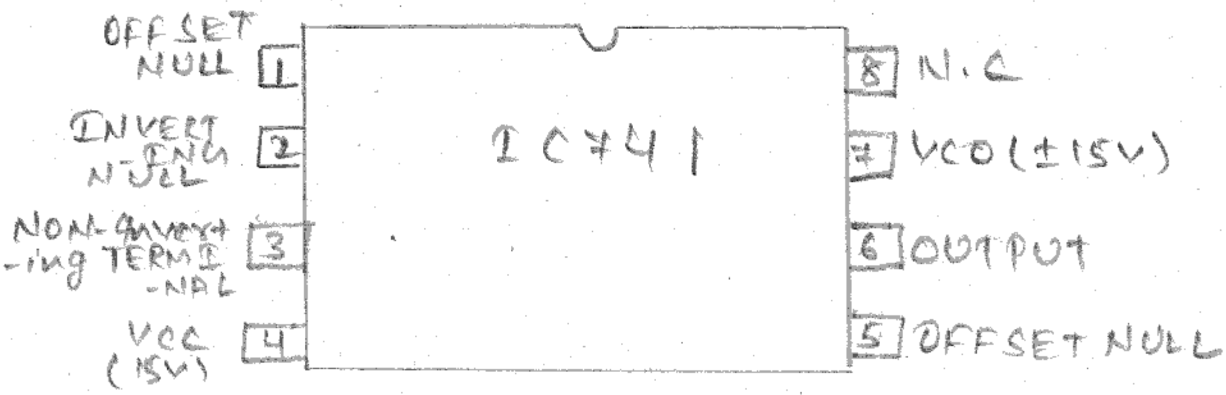
LOW PASS FILTER AND BAND PASS FILTER:-

AIM:- To design a low pass filter and Band pass filter using operational Amplifier

APPARATUS REQUIRED:-

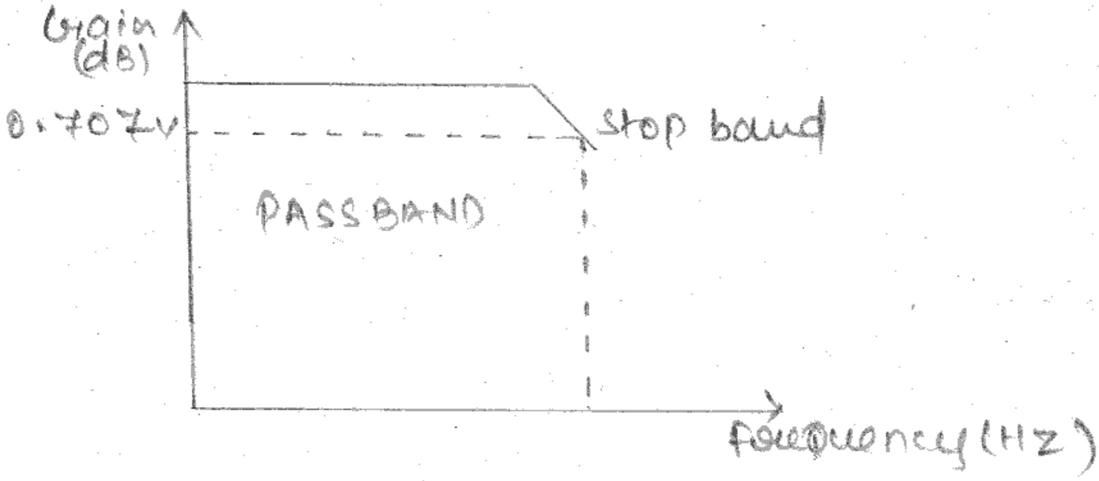
| SL. NO | Components | Range | Quantity |
|---|---|---|---|
| 1. | IC 741 | — | 1 |
| 2. | Resistor | 4.7KΩ, 100KΩ, 10KΩ, | 1 each |
| | | 1.5KΩ, 6.3KΩ | 1 each |
| | | 20KΩ, 10KΩ, 100KΩ | 1 each |
| 3. | Capacitor | 0.1μF, 0.01μF | 1 each |
| 4. | Function generator | (0-30) MHZ | 1 |
| 5. | Power Supply | 15V | 1 |
| 6. | CRO | (0-25) MHZ | 1 |
| 7. | Bread Board | — | 1 |
| 8. | Connecting wires | — | As req. |

## PIN DIAGRAM

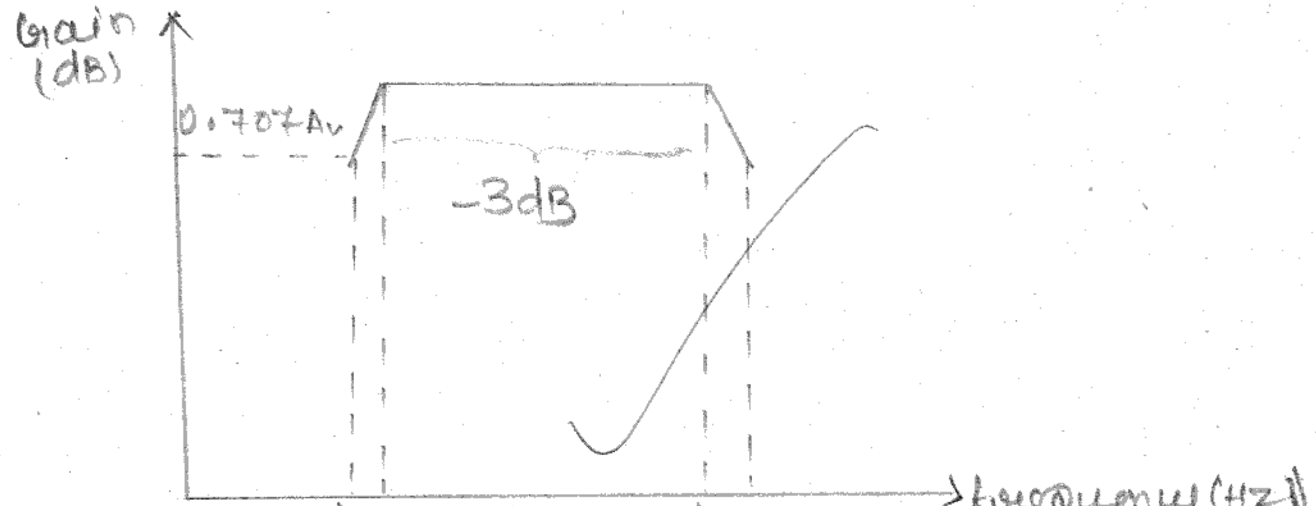



## MODEL GRAPH

### LOW PASS FILTER:-




### BANDPASS FILTER:-



THEORY :-

LOW PASS FILTER

The low pass filter not only removes the high frequency components and noise, but also controls the dynamic characteristics of the PLL. These characteristics include capture and lock range, bandwidth and transient response. If filter bandwidth is reduced, the response time increases. However, reducing the bandwidth of the filter also reduces the capture range of the PPL.

BAND PASS FILTER.

There are two types of bandpass filters which are classified as per the figure of merit or quality factor Q.

(i) Narrow band pass filter ($Q > 10$)
(ii) Wide band pass filter ($Q < 10$)

(i) Narrow band pass filter :- The important parameters in a band pass filter (BPF) are upper and lower cut-off frequencies ($f_H$ and $f_L$), the band width (BW).

TABULAR COLUMN

Low pass filter :-

| Sl.No | Frequency (Hz) | O/P voltage ($V_o$) | $V_o/V_{in}$ (V) | Gain = $20\log V_o/V_{in}$ (dB) |
|---|---|---|---|---|
| 1. | 100 Hz | 4.11 | 4.11 | 12.27 |
| 2. | 200 Hz | 4.11 | 4.11 | 12.27 |
| 3. | 400 Hz | 4.11 | 4.11 | 12.27 |
| 4. | 500 Hz | 4.11 | 4.11 | 12.27 |
| 5. | 600 Hz | 4.11 | 4.11 | 12.27 |
| 6. | 700 Hz | 4.11 | 4.11 | 12.27 |
| 7. | 800 Hz | 4.11 | 4.11 | 12.27 |
| 8. | 900 Hz | 4.11 | 4.11 | 12.27 |
| 9. | 1 KHz | 4.11 | 4.11 | 12.27 |
| 10. | 1.7 KHz | 3.09 | 3.09 | 9.79 |
| 11. | 2 KHz | 2.09 | 2.09 | 6.40 |
| 12. | 3 KHz | 1.85 | 1.85 | 5.34 |
| 13. | 4 KHz | 1.33 | 1.33 | 2.47 |
| 14. | 5 KHz | 1.05 | 1.05 | 0.42 |
| 15 | 6 KHz | 0.69 | 0.69 | -3.22 |
| 16 | 7 KHz | 0.42 | 0.42 | -7.53 |
| 17. | 8 KHz | 0.24 | 0.24 | -12.39 |

Design Procedure

$f_c = 1\,KHz \quad A_f = 10 \quad Q = 3$

let $C_1 = C_2 = 0.01\mu F$

$$R_1 = \frac{Q}{2\pi f_c A_f} = \frac{3}{2\pi \times 100 \times 0.01 \times 10^{-6} \times 10}$$

$$\boxed{R_1 = 4.77\,K\Omega}$$

(ii) Wide band pass filter

→ A wide band-pass filter can be formed by HPF and LPF section. If the HPF and LPF are of the first order, then the band pass filter (BPF) will have a roll-off rate of 20dB/decade.

PROCEDURE:-

(i) Connections are given as per the circuit diagram.

(ii) connect the dual supply voltage of +15V and -15V.

(iii) As input voltage in the range of millivolt is set for a particular frequency then by keeping the voltage control and varying the frequency various outputs voltage are obtained.

(iv) From the observed reading the gain is calculated in decibel.

BAND PASS FILTER

| Sl. No | Frequency (KHz) | Output Vge ($V_o$) Volt | $V_o/V_{in}$ (V) | Gain = 20log $V_o/V_{in}$ (dB) |
|---|---|---|---|---|
| 1. | 1 KHZ | 4.25 | 4.25 | 12.56 |
| 2. | 2 KHZ | 4.54 | 4.54 | 13.14 |
| 3. | 3 KHZ | 4.85 | 4.85 | 13.71 |
| 4. | 4 KHZ | 5.17 | 5.17 | 14.26 |
| 5. | 5 KHZ | 5.46 | 5.46 | 14.74 |
| 6. | 6 KHZ | 5.67 | 5.67 | 15.07 |
| 7. | 7 KHZ | 5.85 | 5.85 | 15.34 |
| 8. | 8 KHZ | 5.95 | 5.95 | 15.44 |
| 9. | 9 KHZ | 6 | 6 | 15.56 |
| 10. | 10 KHZ | 6 | 6 | 15.56 |
| 11. | 11 KHZ | 5.91 | 5.91 | 15.43 |
| 12. | 12 KHZ | 5.75 | 5.75 | 15.19 |
| 13. | 13 KHZ | 5.47 | 5.47 | 14.75 |
| 14. | 14 KHZ | 5.14 | 5.14 | 14.21 |
| 15. | 15 KHZ | 4.74 | 4.74 | 13.51 |
| 16. | 16 KHZ | 4.35 | 4.35 | 12.76 |
| 17. | 17 KHZ | 4.04 | 4.04 | 12.12 |
| 18 | 18 KHZ | 3.67 | 3.67 | 11.29 |
| 20 | 20 KHZ | 3.23 | 3.23 | 10.08 |

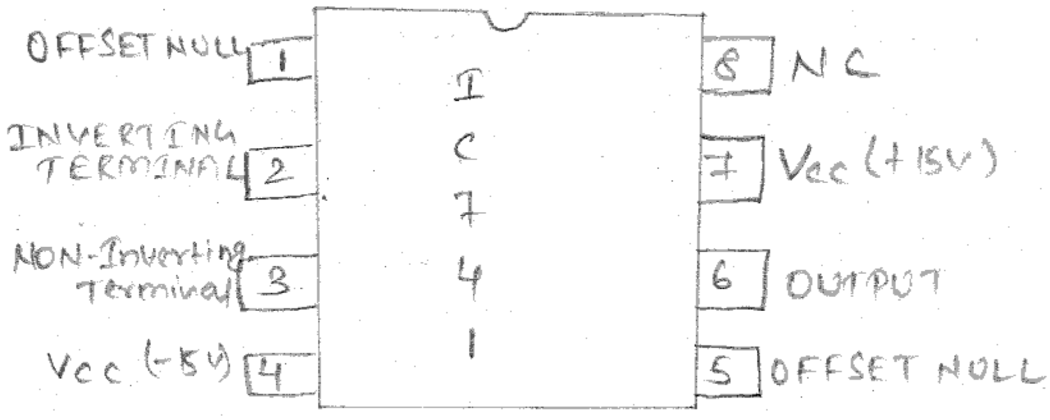
$$R_2 = \frac{Q}{2\pi f_c C(2Q^2 - A_f)} = 8.97$$

$$R_3 = \frac{Q}{\pi f_c \cdot C} = \frac{3}{\pi \times 10^3 \times 0.01 \times 10^{-6}} = 95.5\,k\Omega$$

Hence, $R_1 = 4.7\,k\Omega$, $R_2 = 6.2\,k\Omega$ & $R_3 = 100\,k\Omega$

RESULT:- Thus the low pass filter and high pass filter are designed and the frequency response of those filter was obtained.

PIN DIAGRAM


OFFSET NULL
1
INVERTING TERMINAL
2
NON-Inverting Terminal
3
Vcc (-15V)
4
IC 741
8
NC
7
Vcc (+15V)
6
OUTPUT
5
OFFSET NULL

EXPT. No: 7

DATE: 12.8.2011

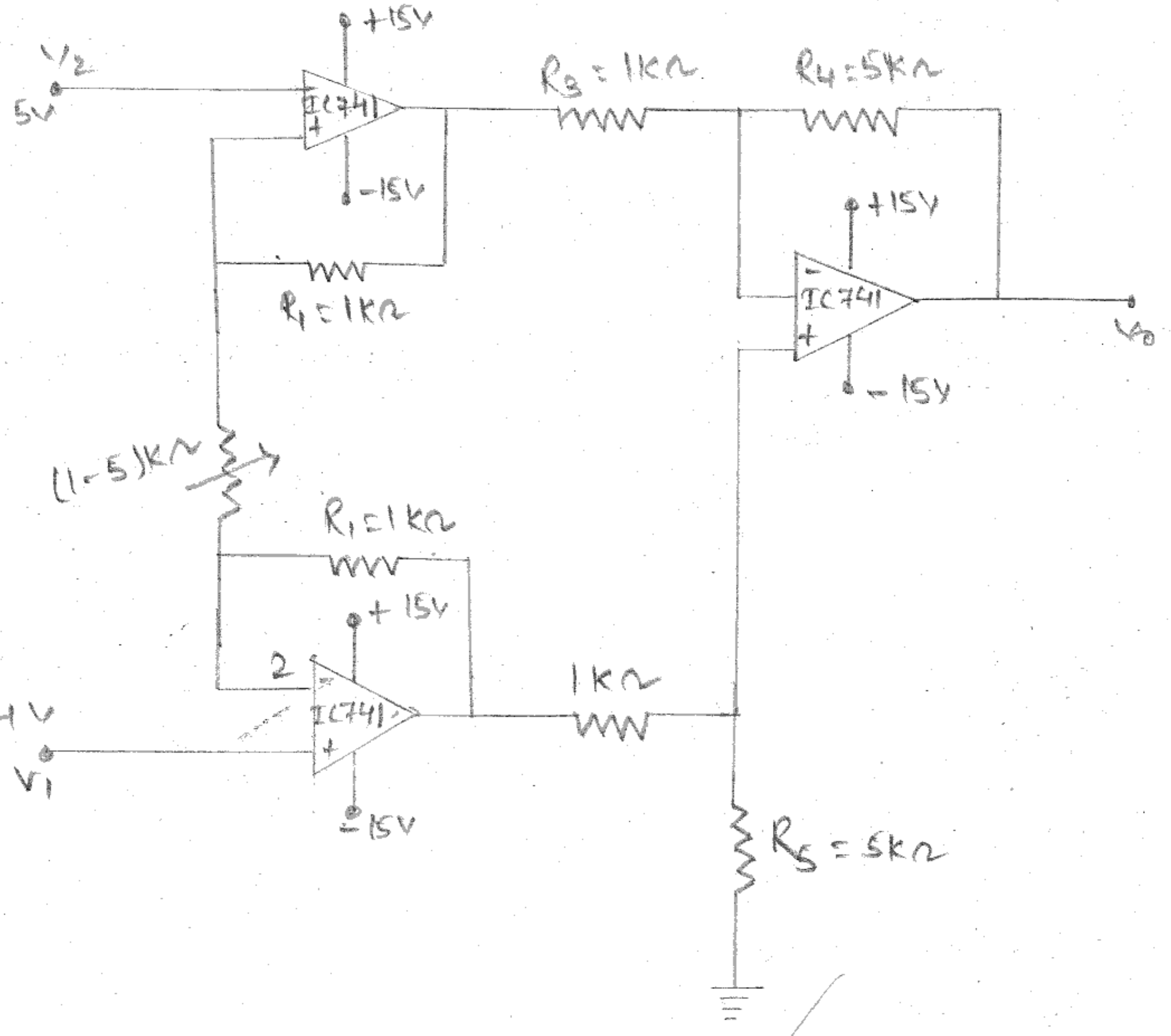
# INSTRUMENTATION AMPLIFIER

AIM: To design an instrumentation amplifier and calculate the output.

APPARATUS REQUIRED:-

| S.No | Components | Range | Quantity |
|---|---|---|---|
| 1 | Op. Amp | IC741 | 3 |
| 2. | Resistor | 1 KΩ | 4 |
| | | 5 KΩ | 2 |
| 3. | variable resistor | ±1.5 KΩ | 1 |
| 4. | RPS | ±15V | 1 |
| 5. | DSO | (0-30)MHz | 1 |
| 6. | Bread Board | — | 1 |
| 7. | Connecting wires | — | As req. |
| 8. | Probes | — | 2 |

Circuit Diagram



THEORY

Instrumentation amplifier is intential for precise low level signal amplifier where low noise, low thermal and time drift, high input resistance and accurate closed loop gain are required. Instrumentation amplifier IC's such as ICL 7605, µA725 are extensive so general purpose amplifier can be employed in the differential mode to amplify low level output signal is the major frequency function of instrumentation amplifier

$$V_1' = R'R + V_1$$

$$V_1 = \frac{R'}{R}(V_1 - V_2) + V_1$$

$$V_2' = -\frac{R'}{R}(V_1 - V_2) + V_2$$

TABULAR COLUMN

| S.No | $V_1$(V) | $V_2$(V) | R(kΩ) | $V_1'$(V) | $V_2'$(V) | Theoritical output (V) | Practical output (V) |
|---|---|---|---|---|---|---|---|
| 1 | 4 | 5 | 1k | 2.75 | 6.05 | 15V | 14.46 |
| 2. | 4 | 5 | 2k | 3.3 | 5.5 | 8.30V | 10.18 |
| 3. | 4 | 5 | 3k | 3.4 | 5.3 | 7V | 8.36 |
| 4. | 4 | 5 | 4k | 3.5 | 5.2 | 7.5V | 7.5 |

Theoritical Calculation

$V_1 = 5V. \quad V_2 = 4V \quad R = 1\,k\Omega$

$$V_1' = \frac{R'}{R}(V_1 - V_2) + V_1$$

$$= \frac{1\times10^3}{1\times10^3}(1) + 5$$

$V_1' = 6V$

$$V_2' = -\frac{R'}{R}(V_1 - V_2) + V_2$$

$$= -\frac{1\times10^3}{1\times10^3}(1) + 4$$

$V_2' = 3V$

PROCEDURE

→ Connection are given as per the circuit diagram

→ The input $V_1$ and $V_2$ are given

→ The output voltage reading are noted.

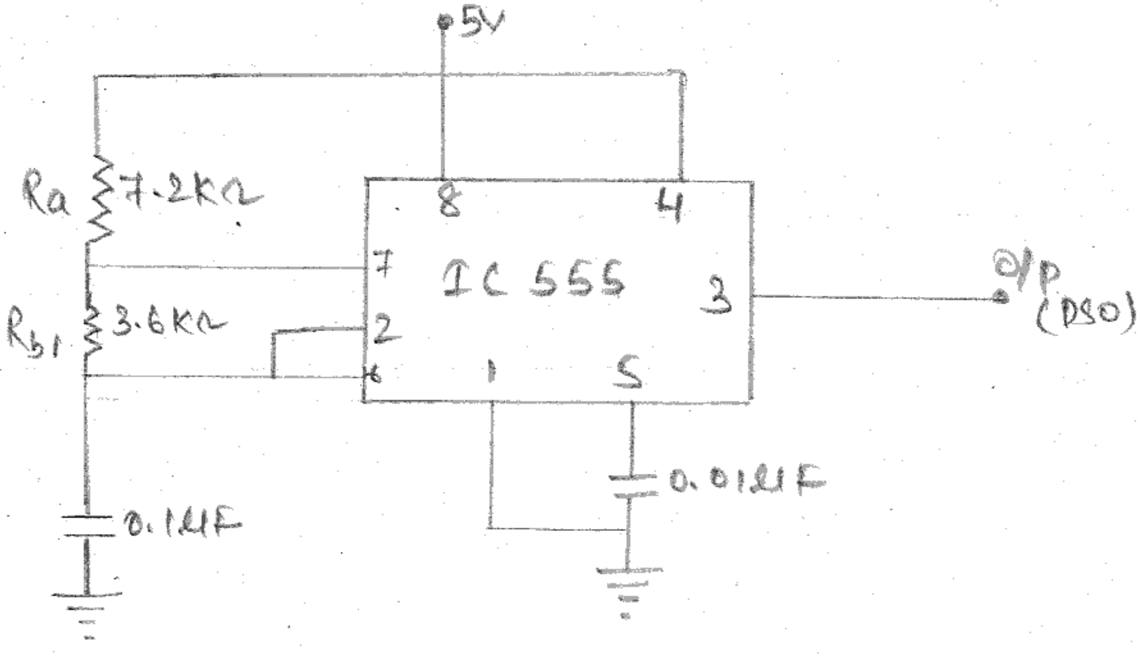
→ The graph is plotted.

$$V_o = (V_1' - V_2') \times 5$$
$$= 3 \times 5$$
$$V_o = 15V$$
$$V_1 = 5V$$
$$V_1' = \frac{R'}{R}(V_1 - V_2) + R$$
$$= \frac{1 \times 10^3}{3.3 \times 10^3} \times (1) + 5$$
$$V_1' = 5.2V$$
$$V_2' = -\frac{R'}{R}(V_1 - V_2) + V_2$$
$$= -\frac{1 \times 10^3}{5 \times 10^3} + 4$$
$$V_2' = 3.8V$$
$$V_o = (V_1' - V_2') \times 5$$
$$V_o = 7V$$

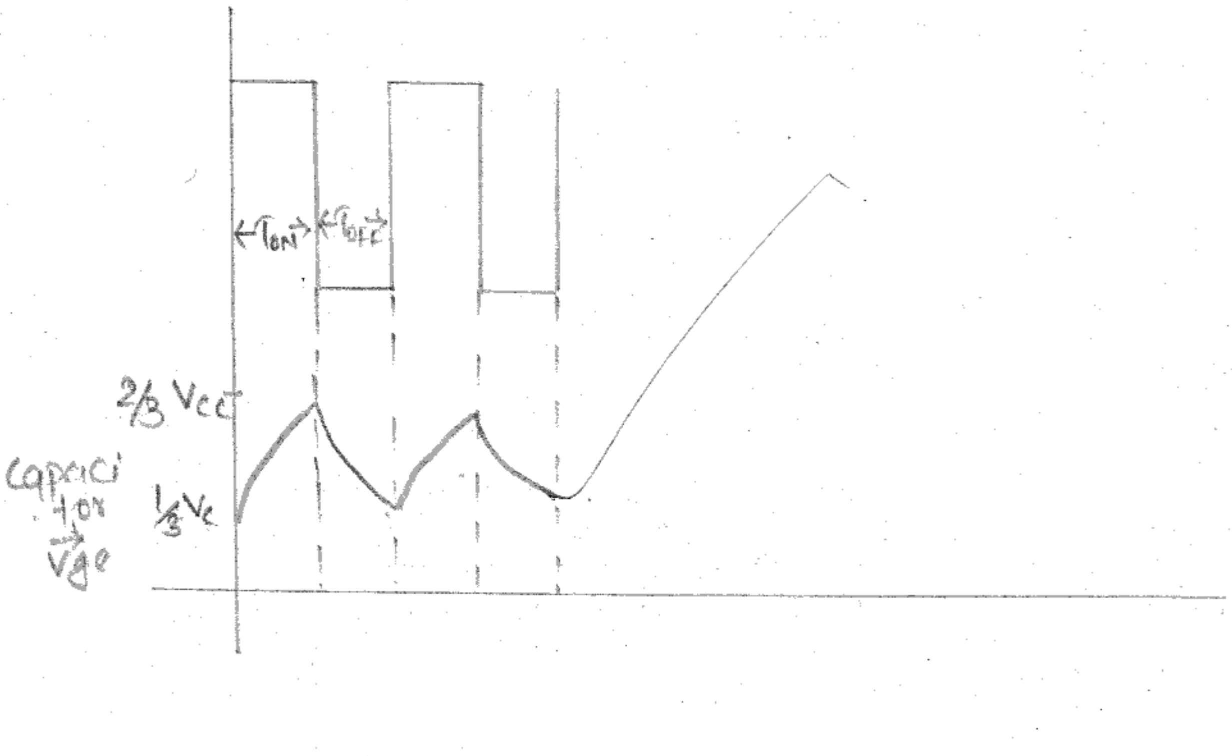
RESULT: Thus the instrumentation amplifier circuit was constructed and output gain was calculated.

Circuit Diagram

Astable Multivibrator




MODEL GRAPH



Exp. No : 8

DATE : 19.8.2011

# MULTIVIBRATOR USING IC555 TIMER

AIM: To design and construct multivibrator using IC555 timer

APPARATUS REQUIRED

| S.NO | Component | Range | Qty. |
|---|---|---|---|
| 1. | Timer | IC555 | 1 |
| 2. | Resistor | 7.2 kΩ | 1 |
| | | 3.6 kΩ | 1 |
| | | 91 kΩ | 1 |
| 3. | Capacitor | 0.1 µF | 1 |
| | | 0.01 µF | 1 |
| 4. | Fixed power supply | ±5V | 1 |
| 5. | DSO | (0-30) MHz | 1 |
| 6. | Bread Board | – | 1 |
| 7. | Connecting wires | – | As req. |

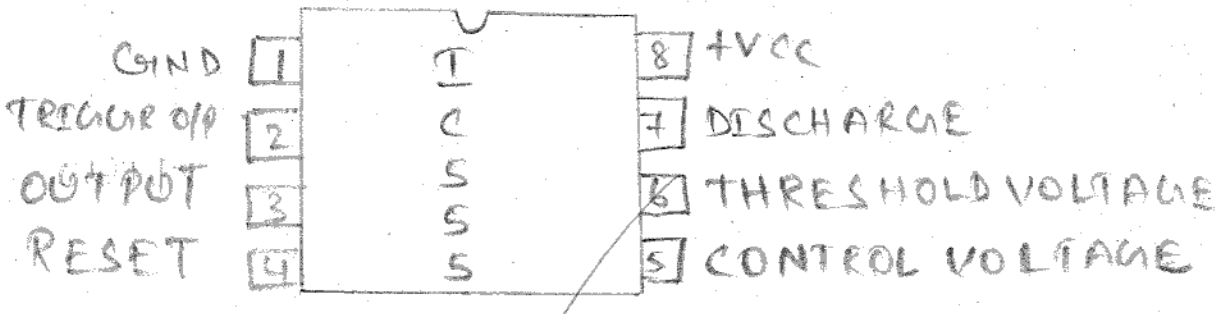
## TABULAR COLUMN : (Square wave)

| Amplitude | Ton (ms) | | Toff (ms) | | Freq (Hz) | |
|---|---|---|---|---|---|---|
| | Theoritical | Practical | Theoritical | Practical | Theoritical | Practical |
| 4.44V | 0.55ms | 800μs | 0.25ms | 260μs | 1KHz | 925.9Hz |

Capacitor Vge

| Amplitude | charge | discharge | frequency. |
|---|---|---|---|
| 1.78V | 820μs | 260μs | 925.9Hz |

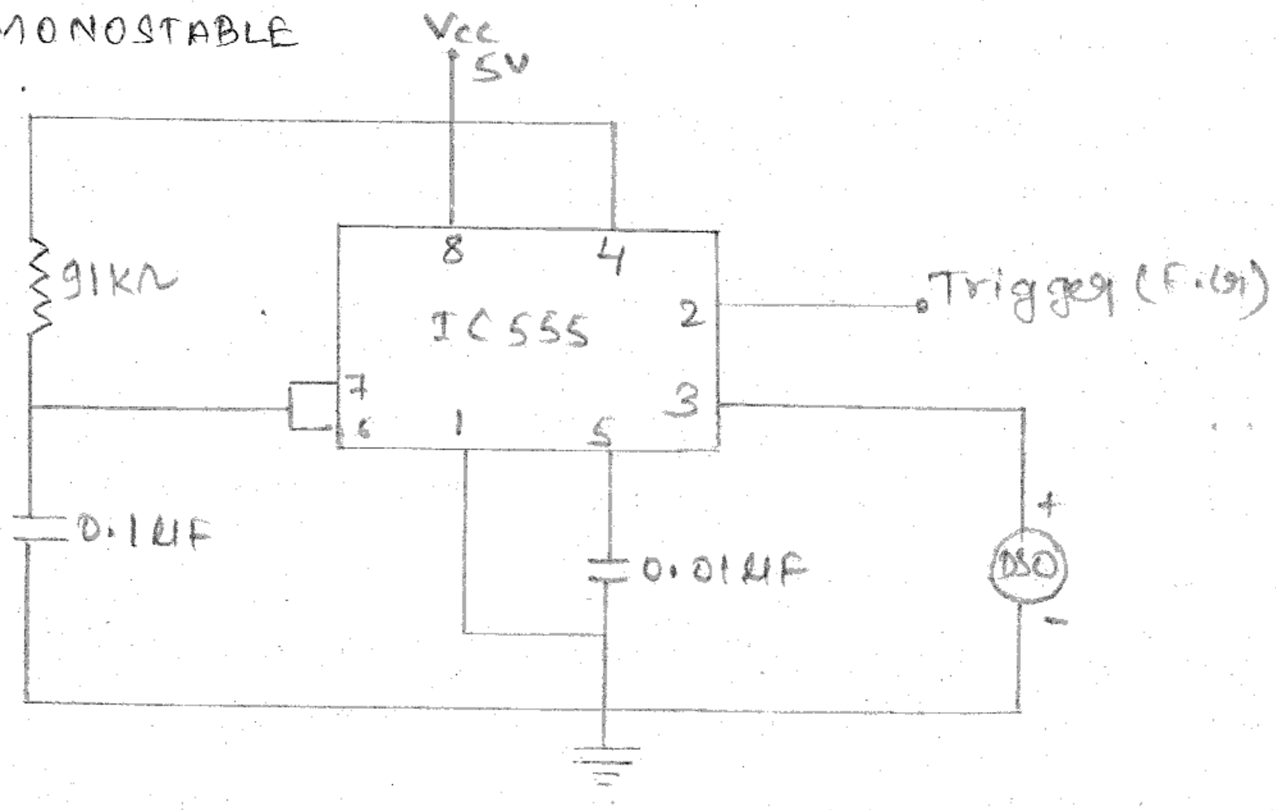
PIN DIAGRAM



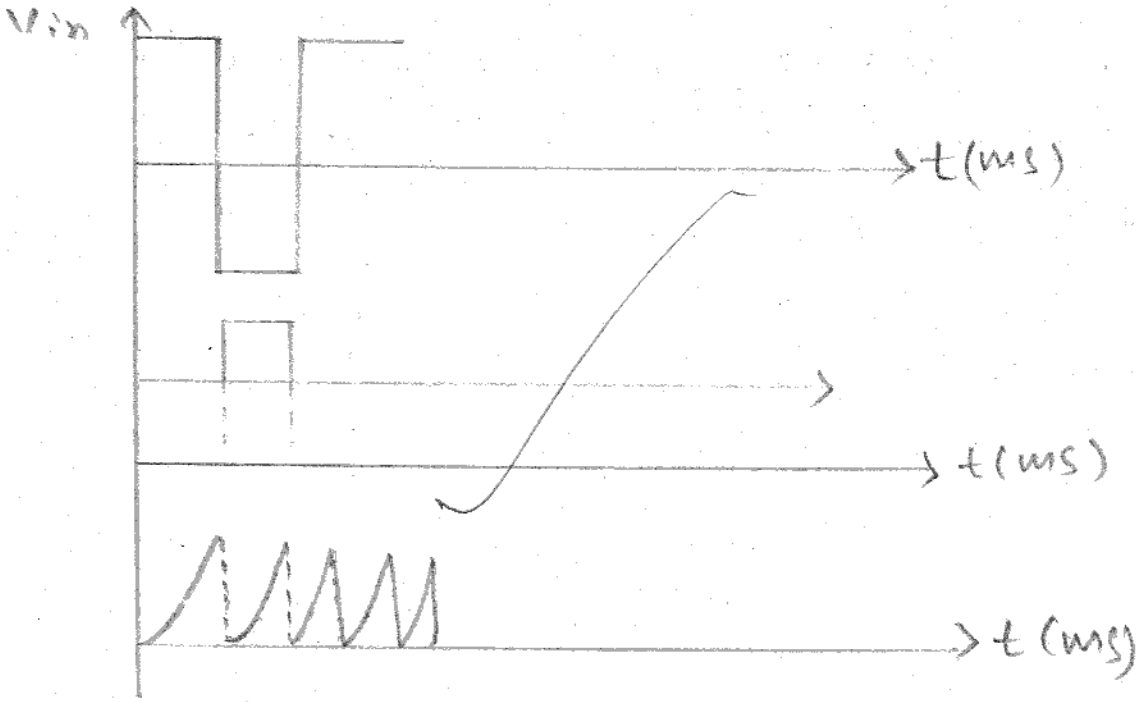
THEORY:-

The electronic circuit which is used to generate the non-sinusoidal wave form are called multivibrator. The monostable multivibrator has only one stable state the other state is unstable called as quasi stable. When an external trigger pulse is applied to circuit, the circuit goes to quasi stable state from its normal state after some time interval, the circuit is automatically return to the stable state. The circuit is used to generate the rectangular wave and hence can be used as to gate other circuit. The time between the transistor from quasi stable state can be predetermined and hence it can be used to introduced time delay with the help of best transistor.

MONOSTABLE




MODEL GRAPH



PROCEDURE:-

① Connect the circuit as per the circuit diagram.

② Apply the trigger signal

③ Observe the i/p and o/p waveform using DSO

④ Draw the required graph.

## TABULAR COLUMN

| | Amplitude | Time period (ms) | | Freq. |
|---|---|---|---|---|
| | | $T_{ON}$ | $T_{OFF}$ | |
| i/p | 3.60 | 560 μs | 480 ms | 1 KHz |
| o/p | 4.48 | | 520 μs | 1 KHz |
| Capacitor vge | 1.58 | 10 ms | 220 μs | |

Design procedure

Astable multivibrator

$f = 1\,KHz \quad D = 75\% = 0.75$

$$f = \frac{1.44}{(R_o + 2R_B)C}\ Hz$$

$$\Rightarrow 1 \times 10^3 = \frac{1.44}{(R_A + 2R_B)C}$$

$$\therefore (R_A + 2R_B)C = 1.44 \times 10^{-3} \quad \text{- - - - (1)}$$

$$\% D = \frac{R_A + R_B}{R_A + 2R_B} \times 100$$

$$\Rightarrow R_A + 2R_B = 1.33(R_A + R_B)$$

$$\Rightarrow 0.66 R_B = 1.33 R_A$$

$$R_B = 0.5 R_A \quad \text{- - - - - (2)}$$

choose $C = 0.1\mu F$

$(R_A + 2R_B) \times 0.1 \times 10^{-6} = 1.44 \times 10^{-3}$

$R_A + 2R_B = 14400$ ---- (3)

Substitute (2) in (3)

$R_A + 2(0.5R_A) = 14400$

$R_A = 7.2 k\Omega$

$R_B = 3.6 k\Omega$   $C = 0.1\mu F$

monostable multivibrator

pulse width $\omega = 10ms$

The pulse width is given by $\omega = 1.1 RC$

$10 \times 10^{-3} = 1.1 RC$

$RC = 9.09 \times 10^{-3} \Omega$

Choose $C = 0.1\mu F$

$$R = \frac{9.09 \times 10^{-3}}{C}$$

$$= \frac{9.09 \times 10^{-3}}{0.1 \times 10^{-6}}$$

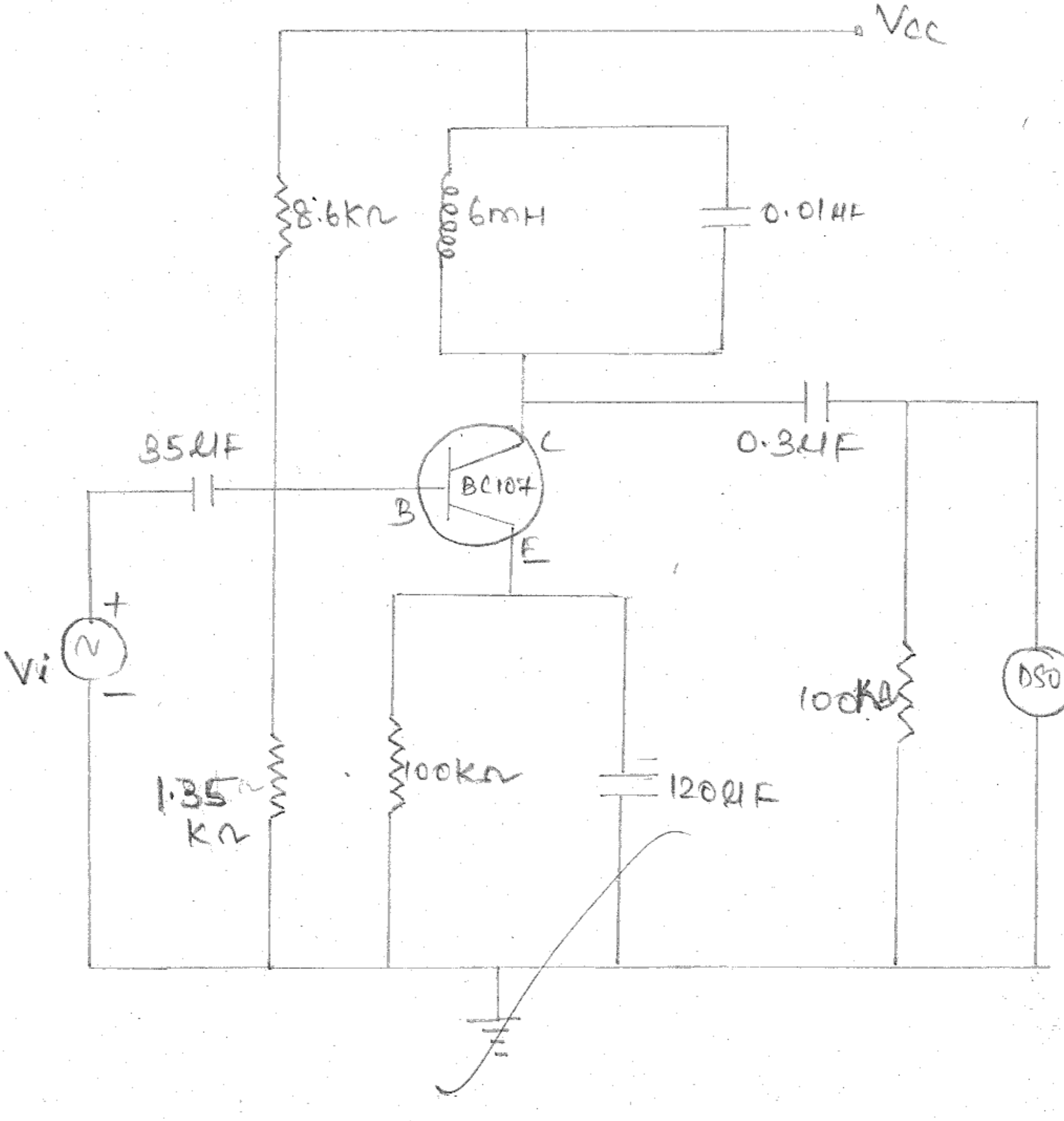
$= 90.90 k\Omega$

$R = 91 k\Omega$

6/8/11

RESULT: Thus a multivibrator is designed and constructed using IC 555 timer.

# CIRCUIT DIAGRAM



Exp. No - 11

DATE: 9.9.11

# CLASS A SINGLE TUNED AMPLIFIER

AIM: To design a single tuned amplifier and to draw its frequency response.

APPARATUS REQUIRED:

| S.No | COMPONENT | RANGE | QUANTITY |
|---|---|---|---|
| 1. | Resistor | 8.56k | 1 |
| | | 1.35k | 1 |
| | | 10k | 1 |
| | | 100k | 1 |
| 2. | Capacitor | 35μF | 1 |
| | | 120 μF | 1 |
| | | 0.3μF | 1 |
| | | 0.01μF | 1 |
| 3. | RPS | (0-30)V | 1 |
| 4. | Transistor | BC107 | 1 |
| 5. | DSO | (0-30)MHz | 1 |
| 6. | F.G | (0-10)MHz | 1 |

DESIGN PROCEDURE:

$V_{cc} = 20V$, $\beta = 150$, $f = 50Hz$, $I_c = 20mA$

$h_{ie} = 4K\Omega$

$I_E = I_c = 20mA$

$V_{CE} = V_{cc}/2 = 20/2 = 10V$

$V_E = V_{cc}/10 = 20/10 = 2V$

$V_B = V_{BE} + V_E = 0.7 + 2 = 2.7$

$I_2 = I_c/10 = \frac{20 \times 10^{-3}}{10} = 2mA$

$R_2 = V_B / I_2 = 2.7 / 2 \times 10^{-3} = 1.35 k\Omega$

$R_1 = \left(\frac{V_{cc} - V_B}{I_2}\right) = \frac{20 - 2.7}{20 \times 10^{-3}} = 8.05 k\Omega$

$Z_{in} = R_B \,||\, h_{ie}$

$R_B = R_1 \,||\, R_2 = (8.05 \,||\, 1.35)k = 1.16 K\Omega$

$= 904 \,\Omega$

$X_{i2} = \frac{904}{10} = 90.4\Omega$

$C_{in} = \frac{1}{2\pi f X_{in}} = \frac{1}{2\pi \times 50 \times 90.4} = 35.2 \mu f$

$C_o = \frac{1}{2\pi f (R_c/10)} = \frac{1}{2\pi \times 50 \times 10 \times 10^3} = 0.318 \mu f$

{ $R_c = 100k$ }

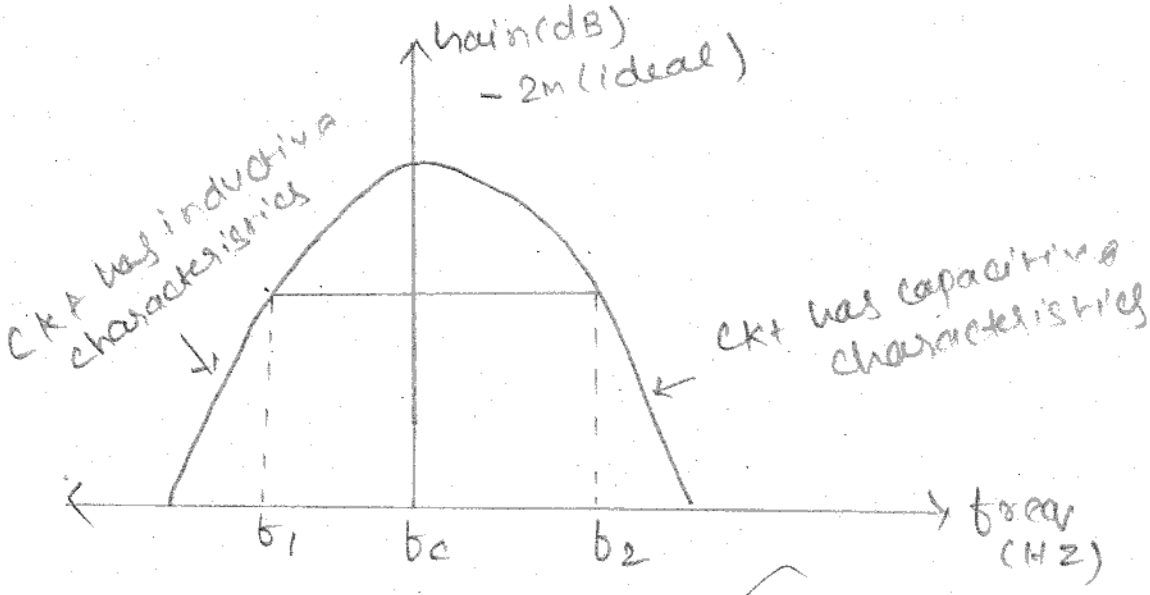
$X_{CE} = \frac{h_{ie}}{1+\beta} = \frac{4 \times 10^3}{1 + 150} = 20.49\Omega$

$= 0.138 \mu F$

$C_E = \frac{1}{2\pi f X_{CE}} = 120 \mu F$

| | | | |
|---|---|---|---|
| 7. | Bread Board | – | 1 |
| 8. | Connecting Wires | – | As required. |

MODEL GRAPH


Gain(dB)
- 2m (ideal)
ckt has inductive characteristics
ckt has capacitive characteristics
f1
fc
f2
freq (Hz)

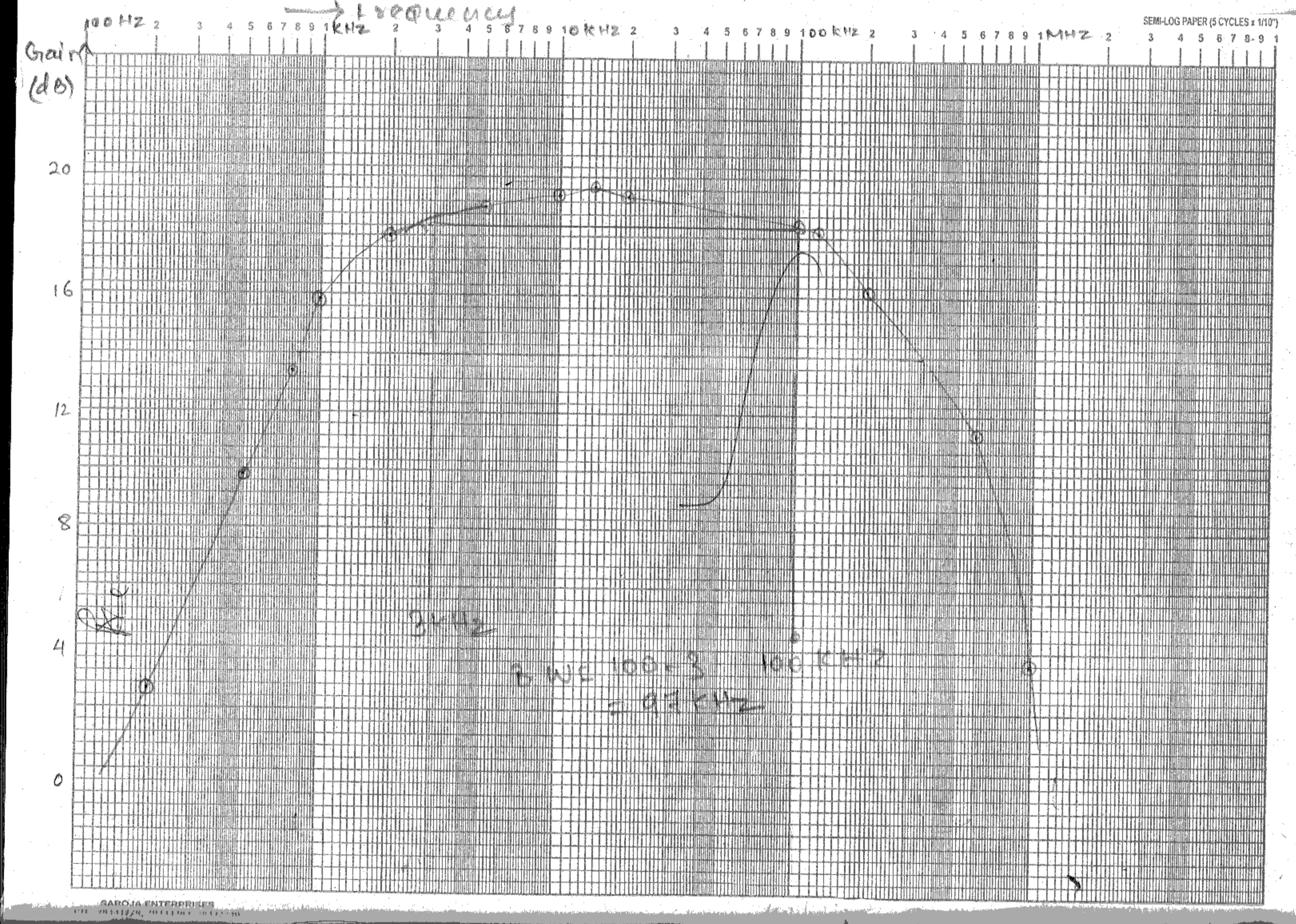
THEORY:-

The Single tuned amplifier selecting the range of frequency. The resistance load replaced by the truth table ckt. The tuned amplifier gives response only at particular frequency at which the o/p is almost zero. The resistance $R_1$ & $R_2$ Provide potential dividing bias. $R_e$ and $C_e$ Provides the thermal stabilization. Thus it fixes up the operating point.

TABULATION

$V_{in} = 1V$

| S.No | Frequency (Hz) | O/P voltage (V) | Gain = 20 log ($V_o/V_i$) (dB) |
|---|---|---|---|
| 1. | 200 Hz | 1.35 KV | 2.60 |
| 2. | 500 Hz | 3.09 KV | 9.79 |
| 3. | 800 Hz | 4.67 KV | 13.38 |
| 4. | 1 KHz | 6.26 KV | 15.93 |
| 5. | 2 KHz | 8 KV | 18.06 |
| 6. | 5 KHz | 9 KV | 19.08 |
| 7. | 10 KHz | 9.42 KV | 19.48 |
| 8. | 11 KHz | 9.50 KV | 19.55 |
| 9. | 12 KHz | 9.42 KV | 19.48 |
| 10 | 100 KHz | 8.64 KV | 18.73 |
| 11 | 120 KHz | 8.22 KV | 18.29 |
| 12 | 130 KHz | 7.35 KV | 17.29 |
| 13 | 200 KHz | 6.44 KV | 16.17 |
| 14 | 230 KHz | 5.54 KV | 14.87 |
| 15 | 600 KHz | 3.70 KV | 11.50 |
| | 1 MHz | 1.53 KV | 3.69 |


SEMI-LOG PAPER (5 CYCLES x 1/10")
Gain (dB)
Frequency
100 Hz
1 kHz
10 kHz
100 kHz
1 MHz
20
16
12
8
4
0
3 kHz
100 kHz
BW = 100 − 3
= 97 kHz
SAROJA ENTERPRISES

PROCEDURE :-

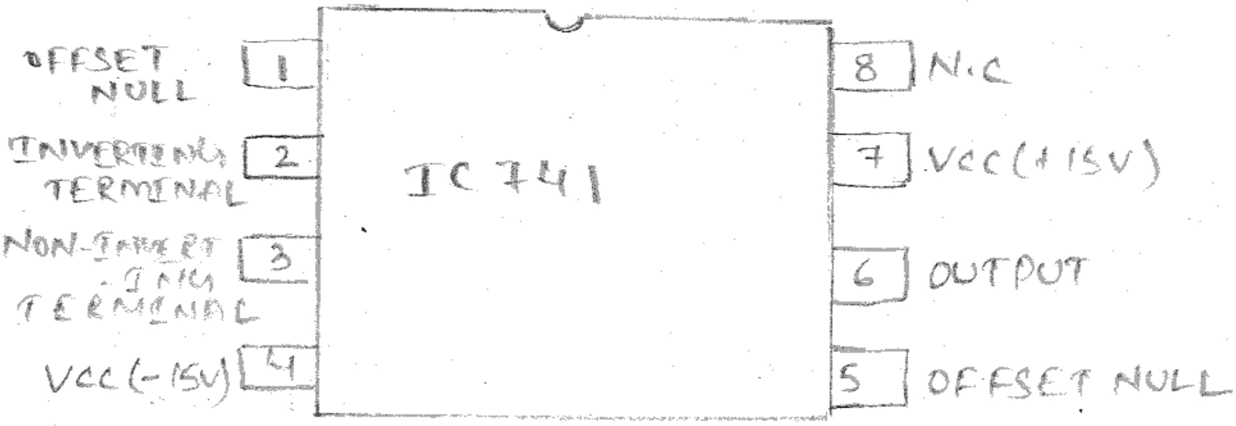
1. Connections are given as per the circuit diagram
2. By varying frequency amplitude is noted down.
3. Gain is calculated in dB.
4. Frequency response curve is plotted.

RESULT:- Thus Class A tuned amplifier is designed and ~~frequency~~ response is plotted.

THEORITICAL FREQUENCY: 20 KHZ

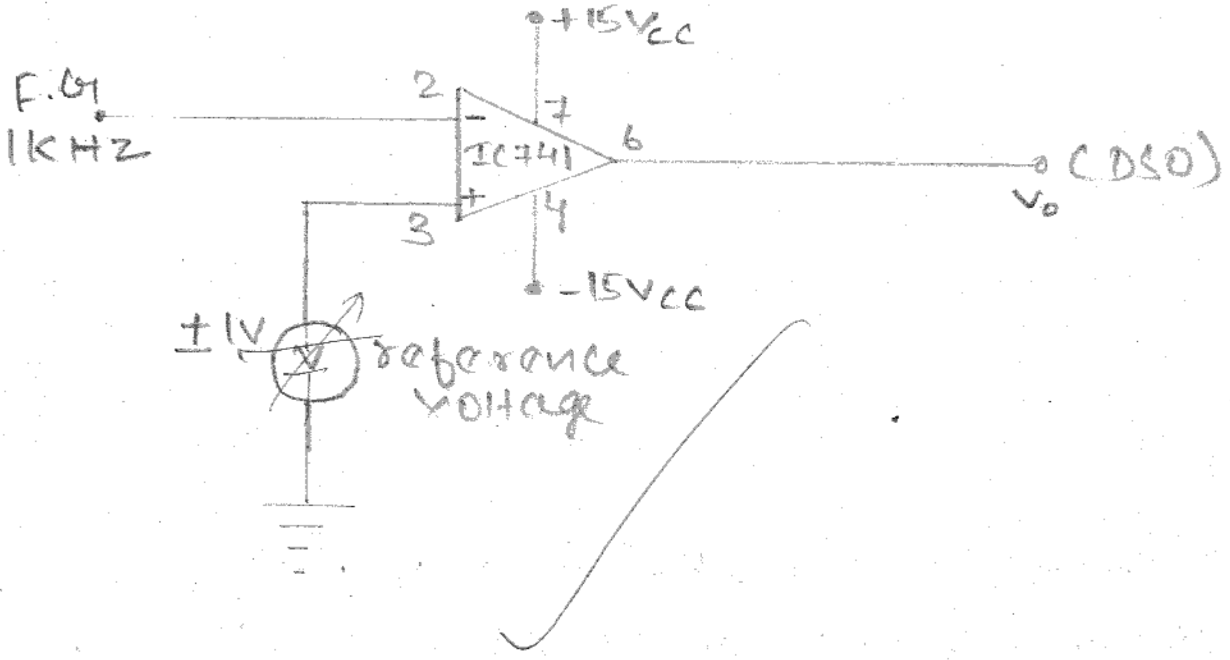
PRACTICAL FREQUENCY: ~~19.48 KHZ~~ 97 KHz

PIN DIAGRAM




CIRCUIT DIAGRAM:

INVERTING COMPARATOR:



EXPT NO - 12

DATE: 10.9.2011

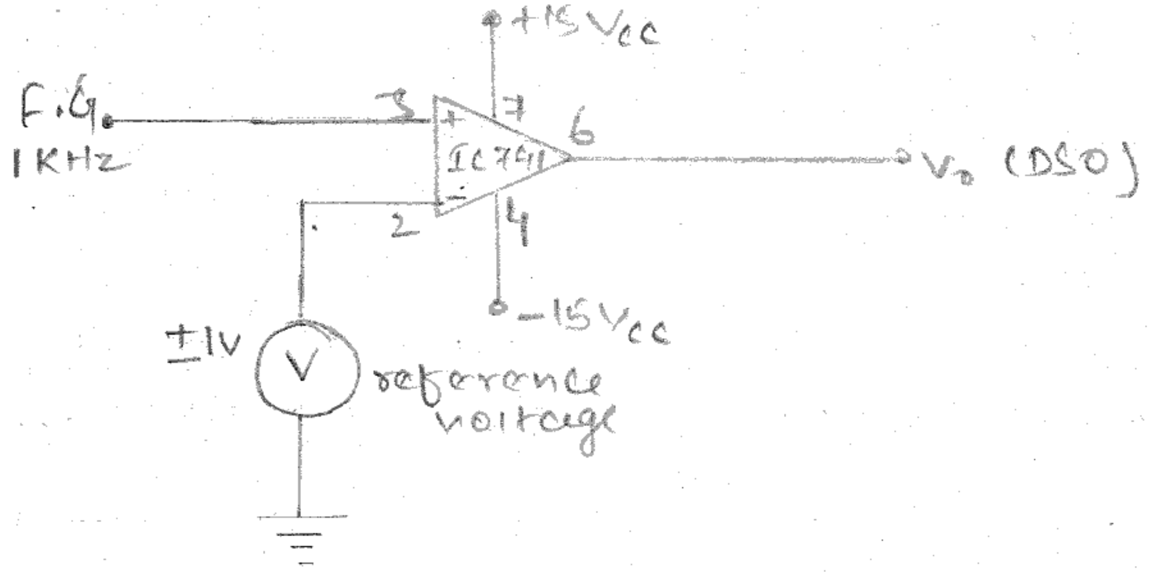
# INVERTING AND NON-INVERTING COMPARATOR

AIM: To study and compare the operation of the comparator circuits using operational amplifier IC741

APPARATUS REQUIRED:-

| S.NO | COMPONENTS | Range | Quantity |
|---|---|---|---|
| 1. | OP-AMP | IC741 | 1 |
| 2. | Power Supply | (0-30)V | 1 |
| 3. | Variable power | ±1V | 1 |
| 4. | DSO | (0-30)MHz | 1 |
| 5. | Function generator | – | 1 |
| 6. | Bread Board | – | 1 |
| 7. | Connecting Wires and Probes | – | 1 |

NON-INVERTING COMPARATOR :-



THEORY:

INVERTING COMPARATOR: In inverting comparator a fixed, Vref is given at the non-inverting terminal, while the time varying signal is given to inverting input terminal. when input s/l $V_i < V_{ref}$, the output is at $+V_{sat}$ and when $V_i > V_{ref}$, the output is at $-V_{sat}$

NON-INVERTING COMPARATOR:- In non-inverting comparator a fixed Vref is given at a negative input terminal and time varying signal is given at positive terminal. when the input signal $V_i < V_{ref}$ the output voltage $-V_{sat}$ and $V_o$ goes to $+V_{sat}$ for the condition $V_i > V_{ref}$.

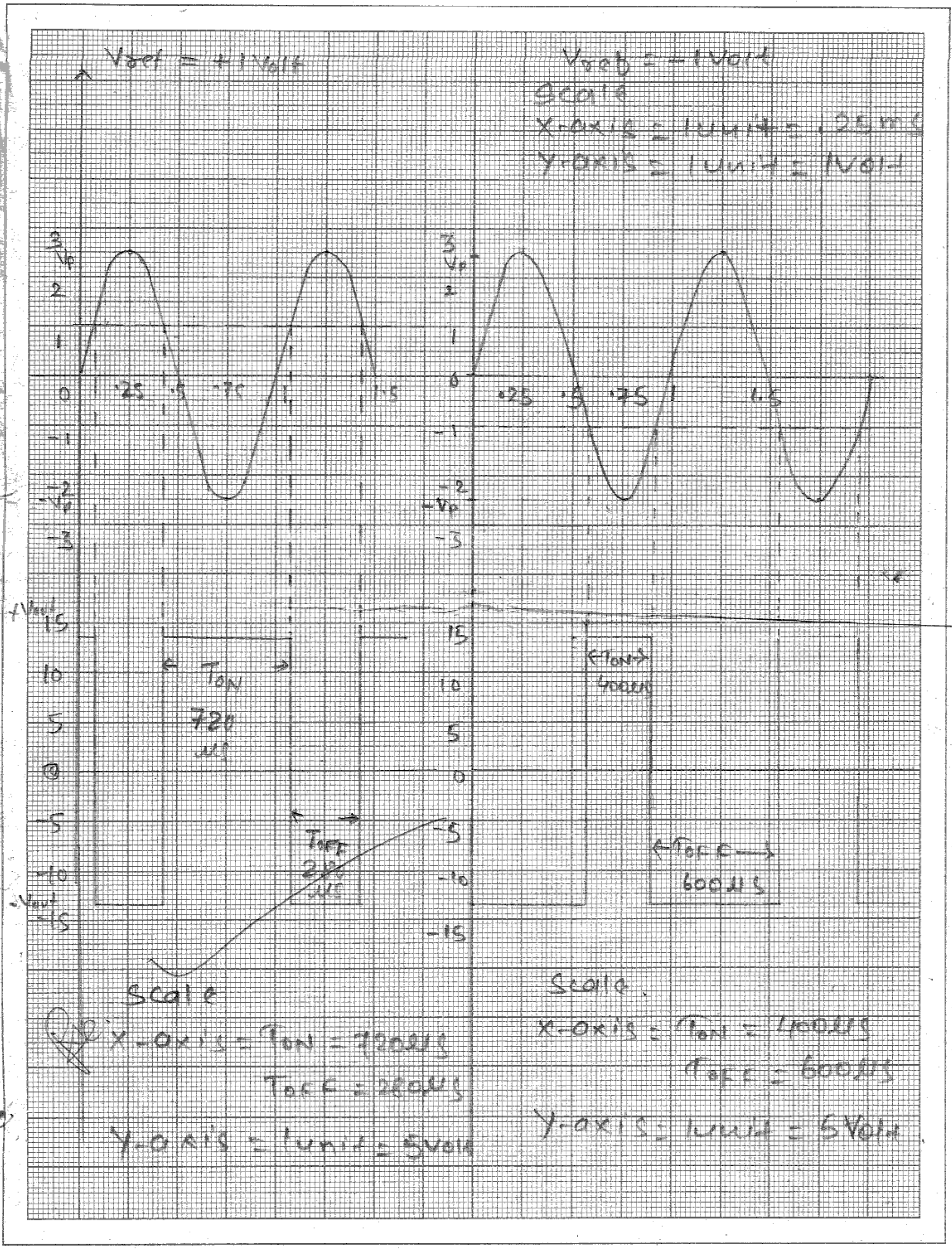
TABULAR COLUMN

INVERTING COMPARATOR :-

| S.No | $V_{ref}$ (V) | Amplitude (V) | | $T_{ON}$ (ms) | $T_{OFF}$ (ms) | T (ms) |
|---|---|---|---|---|---|---|
| | | Vin | Vout | | | |
| 1. | +1V | 5V | 27.6V | 720 µs | 280 µs | 1ms |
| 2. | −1V | 5V | 27.6V | 400 µs | 600 µs | 1ms |

NON INVERTING COMPARATOR :-

| S.No | $V_{ref}$ (V) | Amplitude (V) | | $T_{ON}$ (ms) | $T_{OFF}$ (ms) | T (ms) |
|---|---|---|---|---|---|---|
| | | Vin | Vout | | | |
| 1. | +1V | 5V | 27.6V | 320 µs | 700 µs | 1ms |
| 2. | −1V | 5V | 27.6V | 600 µs | 380 µs | 1ms |


Vref = +1 Volt
Vref = -1 Volt
Scale
X-axis = 1unit = .25 ms
Y-axis = 1unit = 1Volt
TON
720 µs
TOFF
280 µs
←TON→
400µs
←TOFF→
600µs
Scale
X-axis = TON = 720µs
TOFF = 280µs
Y-axis = 1unit = 5Volt
Scale.
X-axis = TON = 400µs
TOFF = 600µs
Y-axis = 1unit = 5Volt

A.P.S

PROCEDURE :-

INVERTING COMPARATOR :-

-> connections are given as per the circuit diagram

-> The input voltage Vin is set during function generator

-> observe the output and input waveform using DSO

-> The graph is drawn.

NON INVERTING COMPARATOR :-

-> connections are given as per the circuit diagram

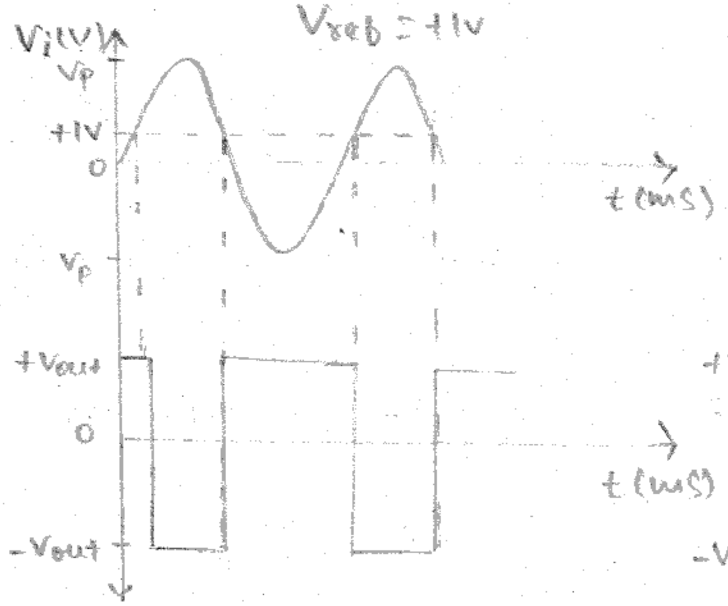
-> The input voltage Vin is set using function generator

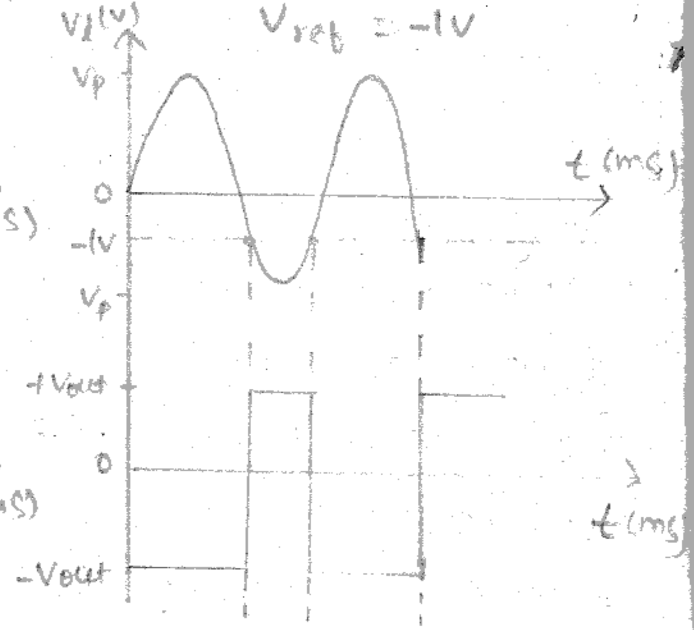
-> observe the input and output waveform using DSO

-> The graph is drawn.

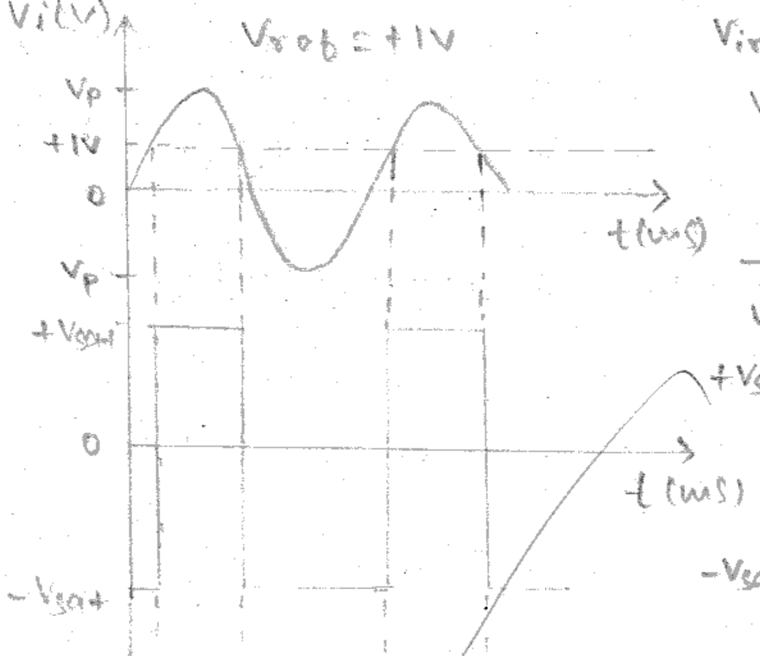
MODEL GRAPH :-

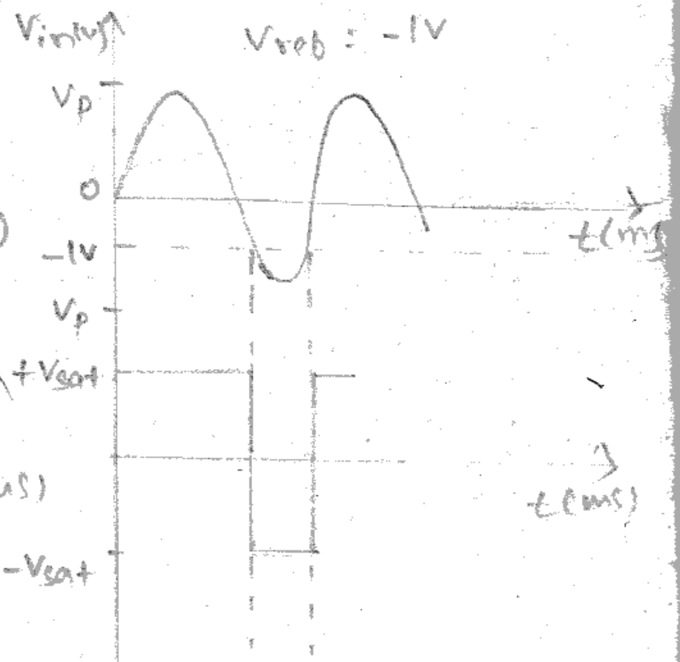
INVERTING COMPARATOR :-

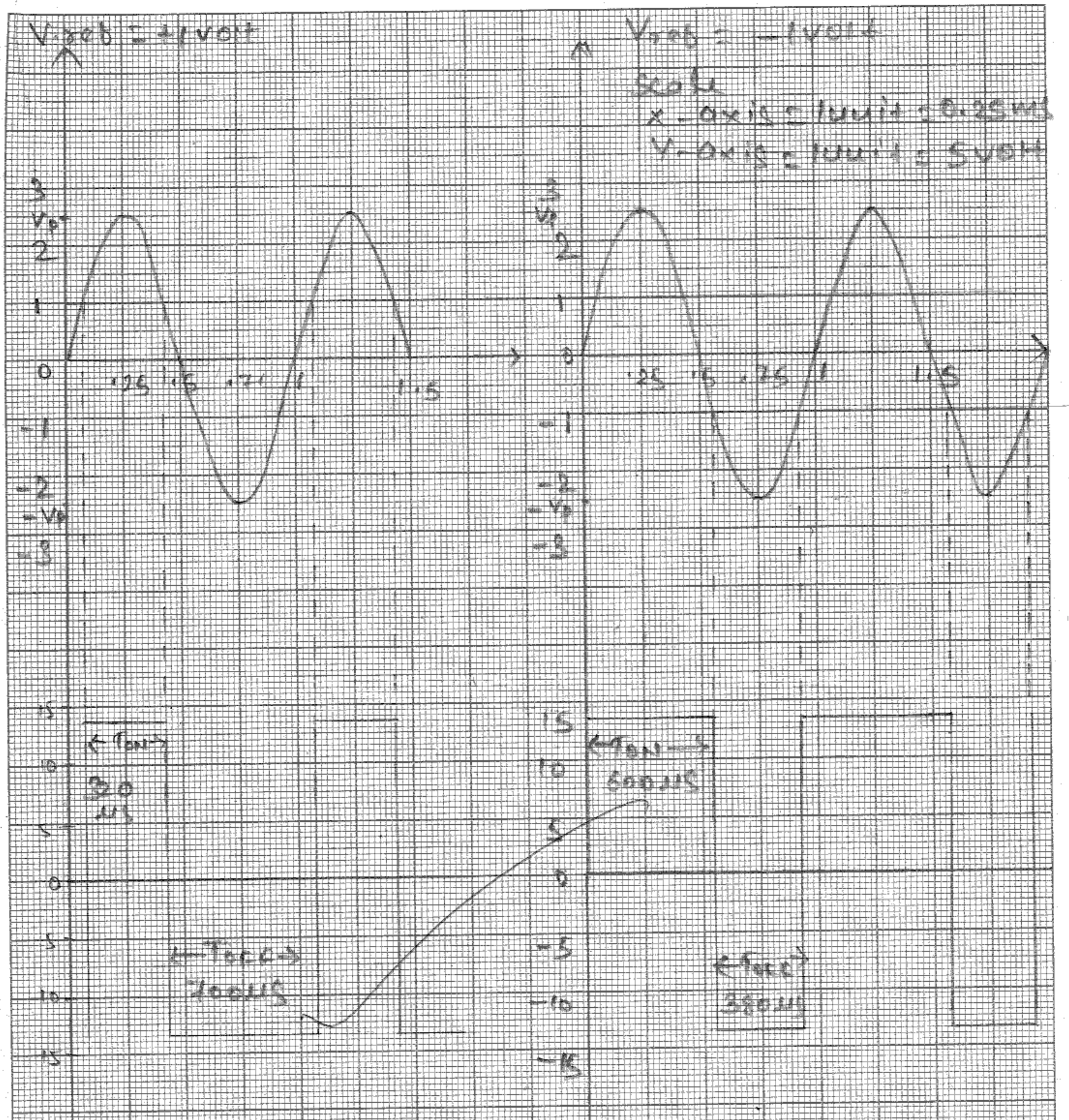



NON-INVERTING COMPARATOR



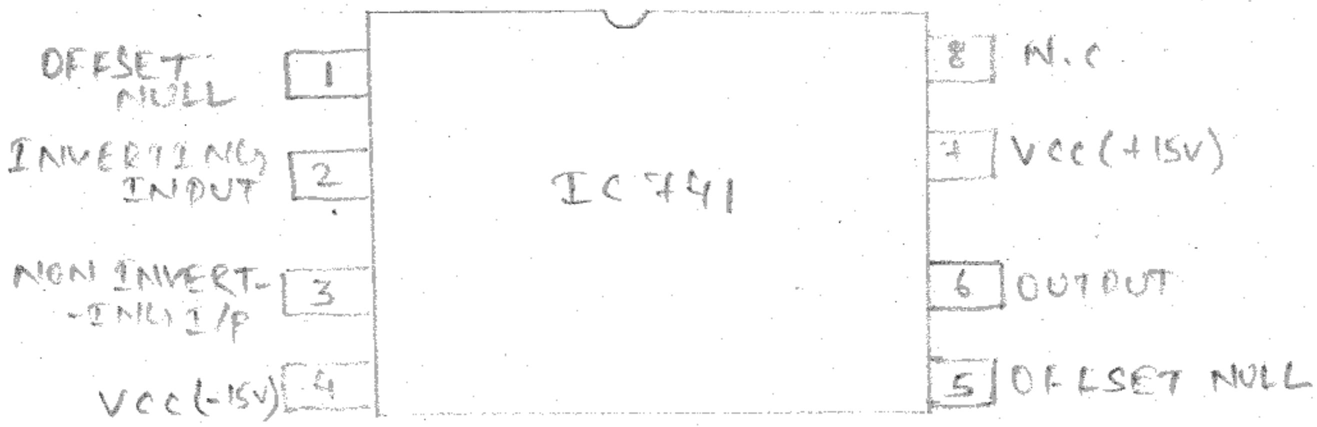


Vref = +1 volt
Vref = −1 volt
Scale
x-axis = 1 unit = 0.25 ms
Y-axis = 1 unit = 5 volt
Vp
−Vp
← Ton →
320 µs
← Toff →
700 µs
← Ton →
600 µs
← Toff →
380 µs
Scale
X-axis = Ton = 320µs
Toff = 700µs
Y-axis = 1 unit = 5 volt
Scale
X-axis = Ton = 600µs
Toff = 380µs
Y-axis = 1 unit = 5 volt

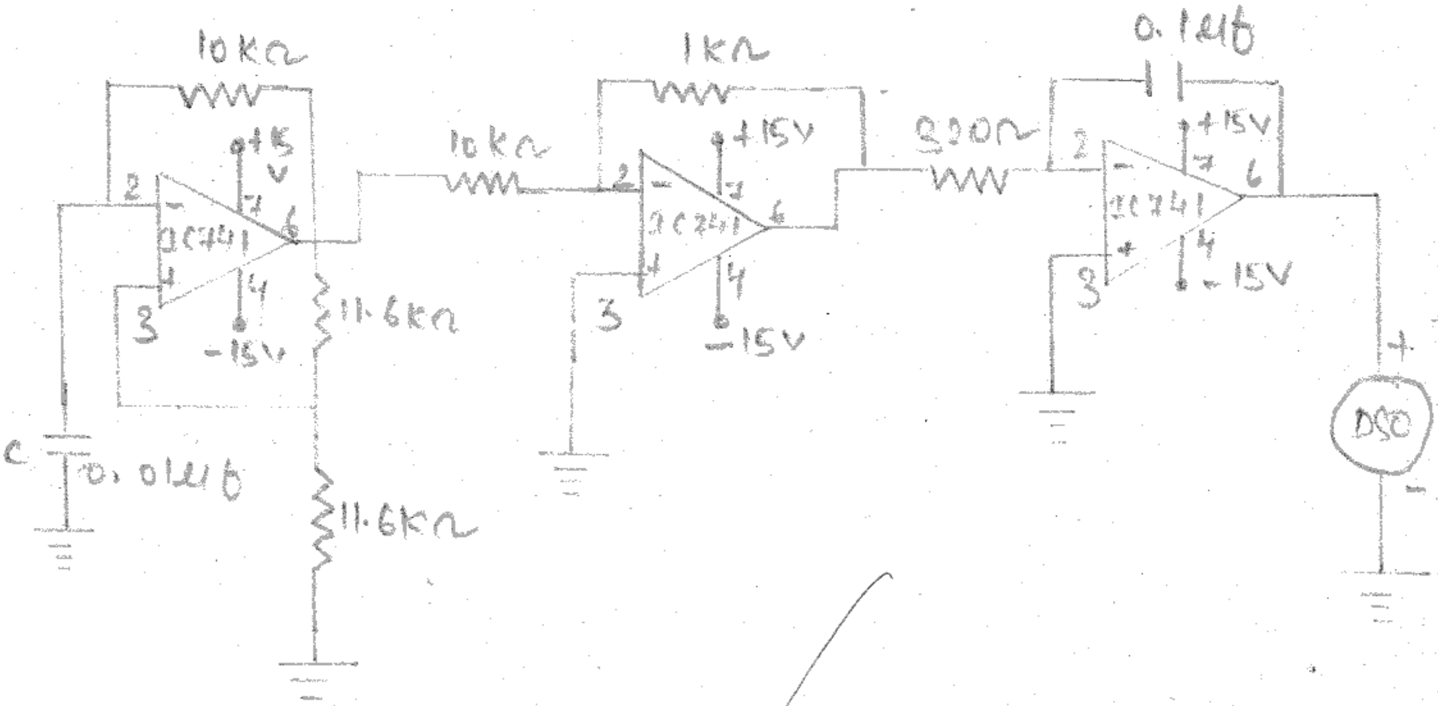

A.P.S

RESULT: Thus the inverting and non-inverting comparator is constructed and tested using Op-amp.

PIN DIAGRAM :-




CIRCUIT DIAGRAM :-



EXPT NO: 13

DATE: 15.9.11

# WAVEFORM GENERATOR

AIM: To construct a waveform generator and generate the square and triangular waveforms.

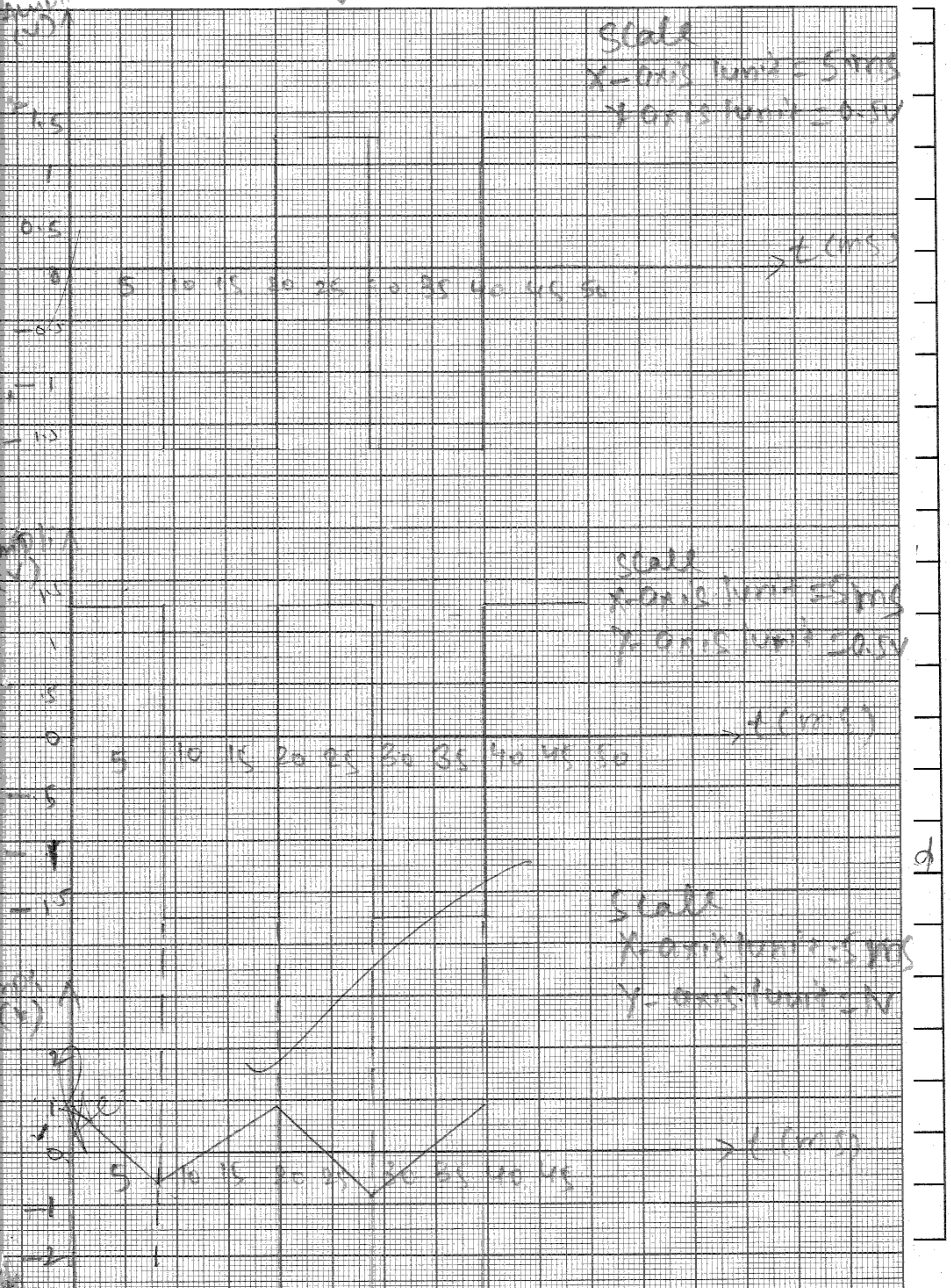
APPARATUS REQUIRED:-

| S. No | COMPONENTS | RANGE | QUANTITY |
|---|---|---|---|
| 1. | OP-AMP | IC741 | 3 |
| 2. | Resistor | 10 kΩ | 3 |
| | | 1 kΩ | 1 |
| | | 11.6 kΩ | 1 |
| | | 320 Ω | 1 |
| 3. | Capacitor | 0.01 µF | 1 |
| | | 0.1 µF | 1 |
| 4. | Fixed power supp | (0-15) V | 1 |
| 5. | DSO | (0-30) MHz | 1 |
| 6. | Bread Board | — | 1 |
| 7. | Connecting wires | — | As reqd. |

TABULAR COLUMN

| | Amplitude(V) | Time Period (ms) | |
|---|---|---|---|
| | | TON | TOFF |
| Astable op-AmpI | 2.5V | 8.4ms | 11.20ms |
| De-amplifier op-amp II | 2.5V | 8.4ms | 11.20ms |
| Integrator op-amp | 1.86V | 9.62ms | 11.2ms |

# Waveform Generator



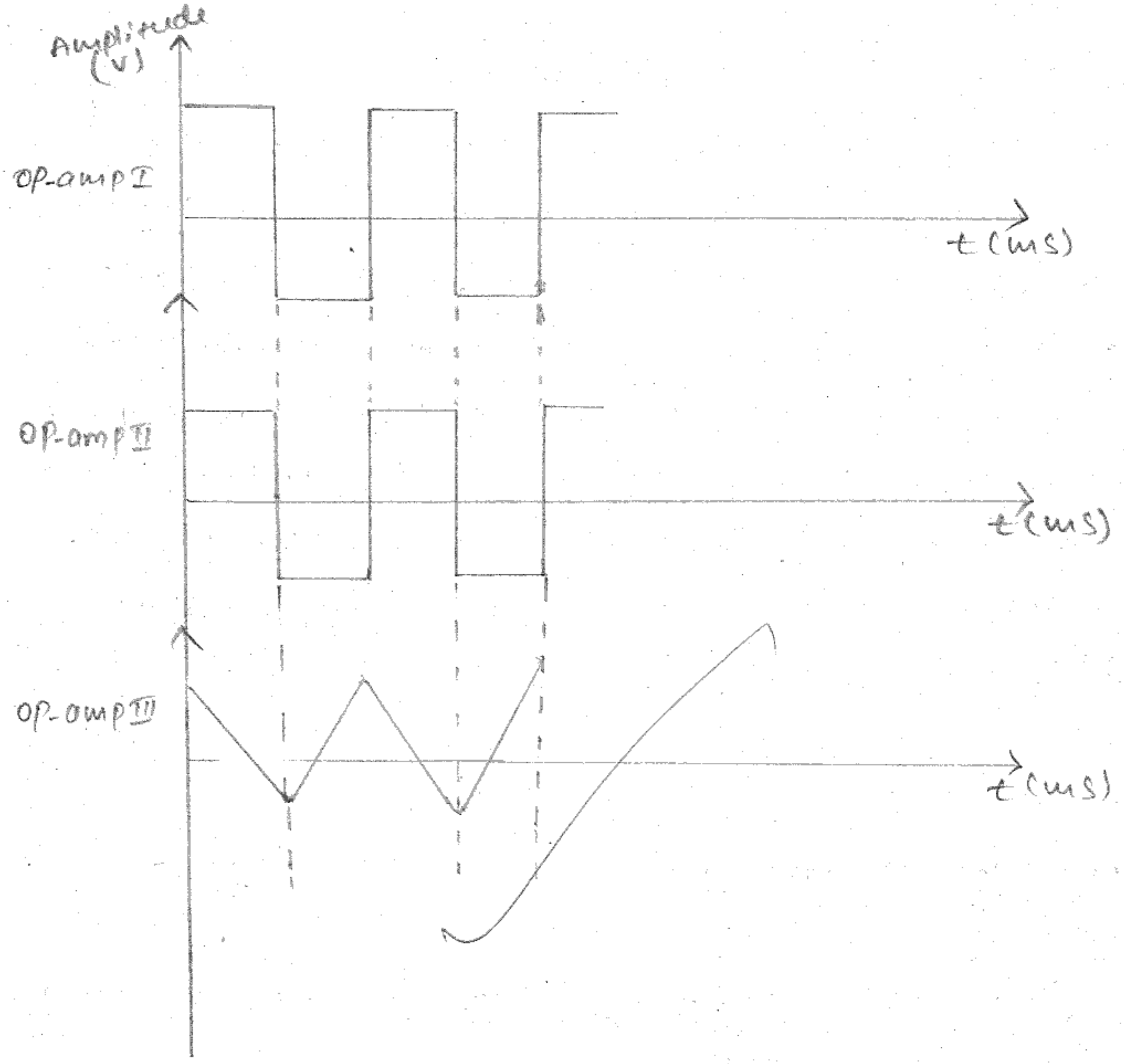
THEORY:-

An integrator can produce triangular waveform when its input is square wave. This means that a triangular wave generator can be found by simply connecting an integrator to square wave generator. The frequency of square wave and triangular wave are same. The frequency of triangular wave generator is limited of slew rate of op-amp. So, high slew rate of op-amp should be used for generation of relatively higher frequencies.

PROCEDURE:-

(1) connections are given as per the circuit diagram
(2) Check the output of first op-amp, it should be a square wave.
(3) Take the reading of frequencies
(4) Take the reading of Triangular wave at output and draw the respective graph

MODEL GRAPH



RESULT :- Thus the waveform generator is constructed and triangular waveform is generated and output is verified