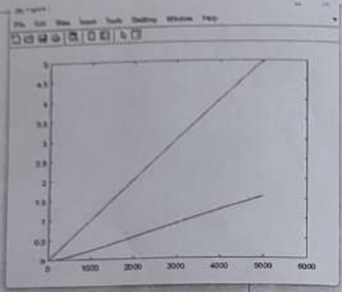
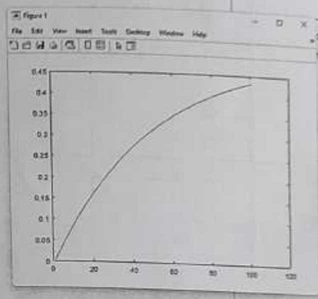
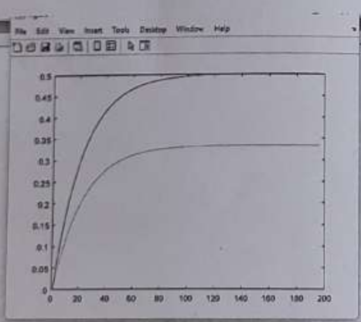
```
clc
clear all
num=[1];
den=[1 2];
g=tf(num,den)
 g1=feedback(g,1)
%  y=step(g,1);
%  plot(y)
%  x=stepinfo(y)
%  grid on


%  a1=impulse(g1,1);
%  plot(a1)
%  x1=stepinfo(a1);
%  grid on
t=[0:0.001:5]
r=t
plot(r);
hold on
a4=lsim(g1,r,t);
plot(a4);
```



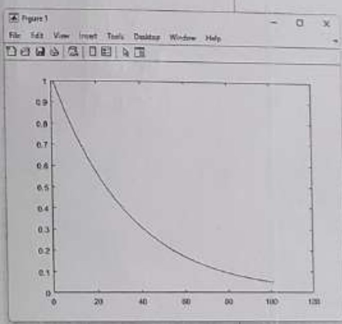

```
clc
clear all
num=[1];
den=[1 2];
g=tf(num,den)
 g1=feedback(g,1)
 y=step(g,1);
 plot(y)
 x=stepinfo(y)
 grid on


%  a1=impulse(g1,1);
%  plot(a1)
%  x1=stepinfo(a1);
%  grid on
% t=[0:0.001:5]
% r=t
% plot(r);
% hold on
% a4=lsim(g1,r,t);
% plot(a4);
```




```
num=[1];
den=[1 2];
g=tf(num,den)

g1=feedback(g,1)
y=step(g1);
plot(y)
hold on
x=stepinfo(y)

num1=[1];
den1=[10 1];
g1=tf(num1,den1)

g3=feedback(g1,1)
y1=step(g3);
plot(y1)
x1=stepinfo(y1)
```

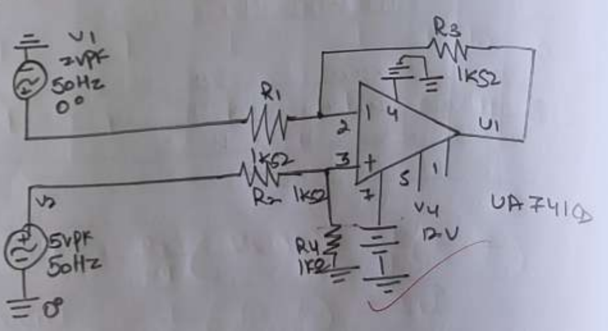


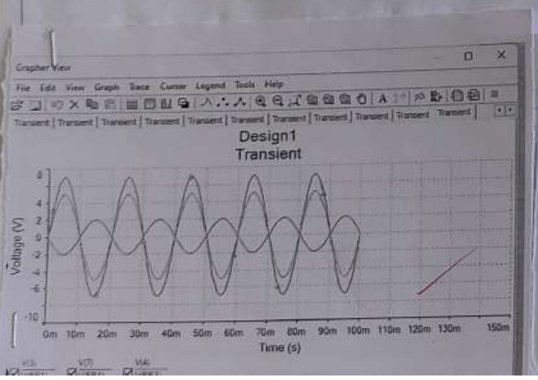

```
clc
clear all
num=[1];
den=[1 2];
g=tf(num,den)
 g1=feedback(g,1)
%  y=step(g,1);
%  plot(y)
%  x=stepinfo(y)
%  grid on


 a1=impulse(g1,1);
 plot(a1)
%  x1=stepinfo(a1);
%  grid on
% t=[0:0.001:5]
% r=t
% plot(r);
% hold on
% a4=lsim(g1,r,t);
% plot(a4);
```



AIM - Design and analysis of op-amp based difference amplifier using multisim

Software - Multisim 14 or above





AIM - Design and analysis of op-amp based difference amplifier using multisim.

Software - Multisim 14 or above

Theory - The differential amplifier is a voltage subtractor circuit which provide an output voltage proportional to voltage difference of two input signal applied to the input of the inverting and non inverting terminal of operational amplifier. This subtraction circuit also amplifies the input voltage provided to it.

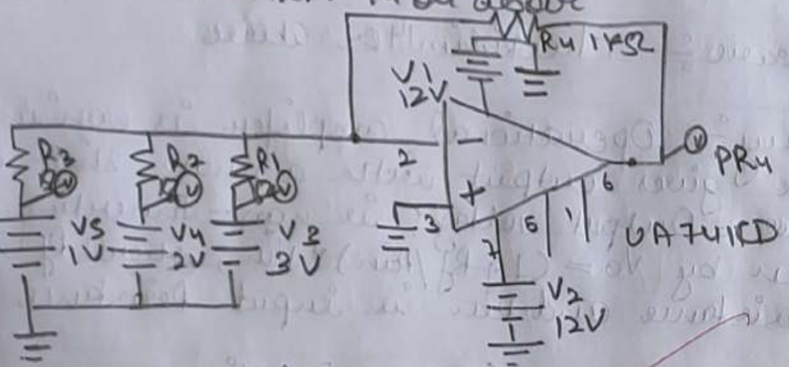
$$V_{out} = -\frac{R_3}{R_1} V_1 + \left(1 + \frac{R_3}{R_1}\right)\left(\frac{R_4}{R_2+R_4}\right) V_2$$

if $R_1 = R_2$ and $R_3 = R_4$

$$V_{out} = \frac{R_3}{R_1}(V_2 - V_1)$$

- Design and analysis of op-amp based summing amplifier using multisim

Software - Multisim 14 or above



observation Table:

R_1	R_2	R_3	Input voltage V_5	V_4	V_3	Output volt (calc)	Output Voltage (from prac)
1KΩ	1KΩ	1KΩ	1V	2V	3V	−6V	−6V
2KΩ	7KΩ	3KΩ	3V	6V	9V	−6.35	−6.3V
1KΩ	1KΩ	6KΩ	3V	6V	9V	−10V	−10V

EXPT. NO. NAME:

Page No.: Date: 19/2/24

AIM: Design and analysis of Op-amp based summing amplifier using multisim

Software - Multisim 14 or above

Result: Increasing the I/P voltage increase the O/P voltage. Decrease the I/P resistance increase O/P voltage. Increasing the feedback resistance increase the O/P

$$V_{out} = -\left\{ \frac{R_4}{R_3} V_5 + \frac{R_4}{R_2} V_4 + \frac{R_4}{R_1} V_3 \right\}$$

$$= -R_4 \left\{ \frac{V_5}{R_3} + \frac{V_4}{R_2} + \frac{V_3}{R_1} \right\}$$

AC summing?

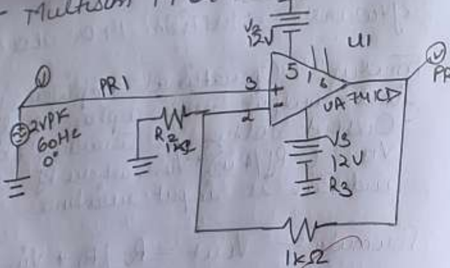
26/2

Teacher's Signature:

AIM :- Design and analysis of op-amp non-inverting amplifier

Software :- Multisim 14 or above

Diagram :-



S.no	Values of R_1	Values of R_2	Input voltag	Output Calculated	Output (from prac)
1	5KΩ	1KΩ	3Vpk	3.6Vpk	+3.6Vpk
2	5KΩ	2KΩ	5Vpk	7Vpk	+7Vpk
3	1KΩ	1KΩ	3Vpk	6Vpk	+6Vpk

AIM :- Design and analysis of op-amp Non-inverting amplifier

Software :- Multisim14 or above

Theory :- Operational amplifier is non inverting mode gives output with a phase shift of 0 degree. Output voltage is non-Inverting mode is given by $V_o = (1 + R_f/R_{in}) * V_{in}$, where R_f is feedback resistance and R_{in} is input Resistance

Formula :- $V_{out} = (1 + R_2/R_1) * V_{in}$

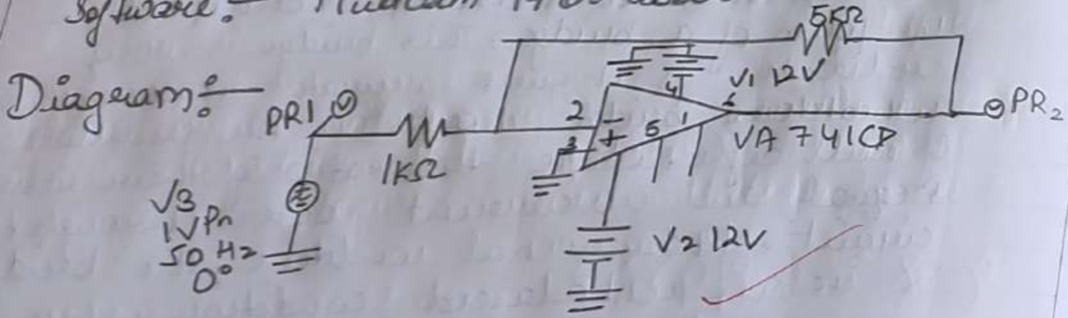
Result :- The O/P = I/P (1 + ratio of feedback R to input. As we increase the value of R_f, the magnitude of O/P voltage degree

19/2

AIM:- Design and ... amplifier

Software:- Multisim 14 or above

Diagram:-



...rvation table:-

Value of R_1.	Value of R_2	Input Voltage	Output Voltage (Calculate)	Output Voltage (from peak)
15KΩ	6KΩ	5Vpk	-12.5Vpk	-10Vpk
15KΩ	6KΩ	1VpK	-2.5VpK	-2.5VPK
5KΩ	1KΩ	1Vpk	-5Vpk	-5VPK

EXPT. NO. | NAME: | Page No. | Date:

AIM:- Design and analysis of omp-amp based Inverting amplifier

Software:- Multisim 14 or above

Theory:- Operational Amplifier is Inverting mode gives output with a phase shift of 180 degree. Output voltage in Inverting Mode is given by $V_O = (-R_f/R_{in}) * V_{in}$, where R_f is feedback resistance and R_{in} is input resistance

Formula:- $V_{out} = R_2/R_1 * V_{in}$

Result:- Verifies that the circuit is inverting configuration, so the O/P is 180° out of phase with I/P.

Discussion:-
Saturation in 1st observation at 10VpK is due to two voltage sources of ±12V attached which is leading to output ~~clipping~~ dropping voltage limits. that's why +12.5 Vpk input voltage. Opp voltage at 10V is ~ 80% of Vcc
$V_{CC} = +12V$

19/12

EXPT. NO. | NAME: | Page No.: | Date: | YOUVA

The wheatstone bridge circuit comprise two unknown resistors, one unknown resistors and one variable resistor connected in the form of a bridge. This bridge is very reliable as it gives accurate measurements wheatstone bridge works on the principle of null deflection, ie the ratio of their resistance is equal and no current flows through the circuit. Under normal condition, the bridge is in an unbalanced condition when no current flows through the galvanometer

12/2

P/Q	R (from kit) Ω	X = (P/Q)*R	X (Actual)
1	10.3KΩ	10.3K	10KΩ
1	1KΩ	1K	1KΩ
1	2.2KΩ	2.2K	2.2KΩ
1	392Ω	392K	300Ω
1	100KΩ	100k	100KΩ

$$\% \text{ error} = \frac{|\text{Actual value} - \text{closed value}|}{\text{Actual value}} \times 100\%$$

error 1 = 3%
error 2 = 0%
error 3 = 0%
error 4 = 30%
error 5 = 0%

EXPT. NO. NAME: Page No.: Date: YOUVA

5) The sensitivity knob is now moved to its maximum position at this near balance condition and once again the bridge is balanced by varying slightly.

6) At balance, the corresponding balance resistor R value is recorded and the unknown resistance is calculated using the equation.

7) $X = (P/Q) * R$

8) The above procedure is repeated for different values of the (P/Q) ratio and the reading are entered in a tabular column.

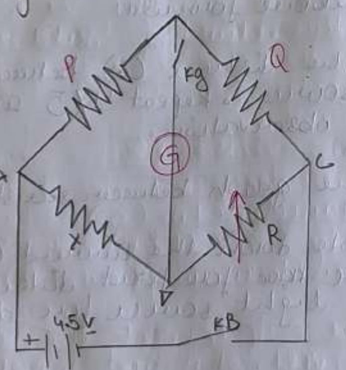
Result :- The medium resistance of the given specimen using Whetstone's bridge and are to be found to be : Medium Resistance = ------ Ω.

Theory :- Wheatstone bridge, also known as the resistance bridge, calculates the unknown resistance by balancing the two legs of the bridge circuit. One leg includes the components of unknown resistance.

AIM :- To measure the unknown medium resistance by using wheatstone's bridge

Apparatus :- 1) Built in wheatstone's bridge
2) 4.5V Dry cell 3) Medium resistance specimen
4) Connecting wires

Circuit Diagram



Experiment - 06

AIM :- To measure the unknown medium resistance by using wheatstone's bridge

Apparatus Required :- 1) Built in wheatstone's Bridge
2) 4.5V Dry cell or regulated power supply unit
3) Medium resistance specimens
4) Connecting wires

Procedure :- 1) The circuit connection are made as per the circuit diagram shown in figure.

2) Across the terminals X1 and X2 where the known resistance is to be connected, the field coils (F1F2) of a DC machine is connected whose coil resistance is to be measured.

3) Initially the (P/Q) ratio of the bridge ~~is~~ adjusted to a particular value using the ratio selector switch

4) Keeping the sensitivity knob in/ its minimum position the bridge is balanced by varying the balance resistance "R" which can be verified by the null deflection in the galvanometer.

$R = \frac{3}{0.6} \times 10^3 = 5k\Omega$

$R = \frac{3}{0.7} \times 10^3 = 5k\Omega$

$R = \frac{3}{0.8} \times 10^3 = 3.75k\Omega$

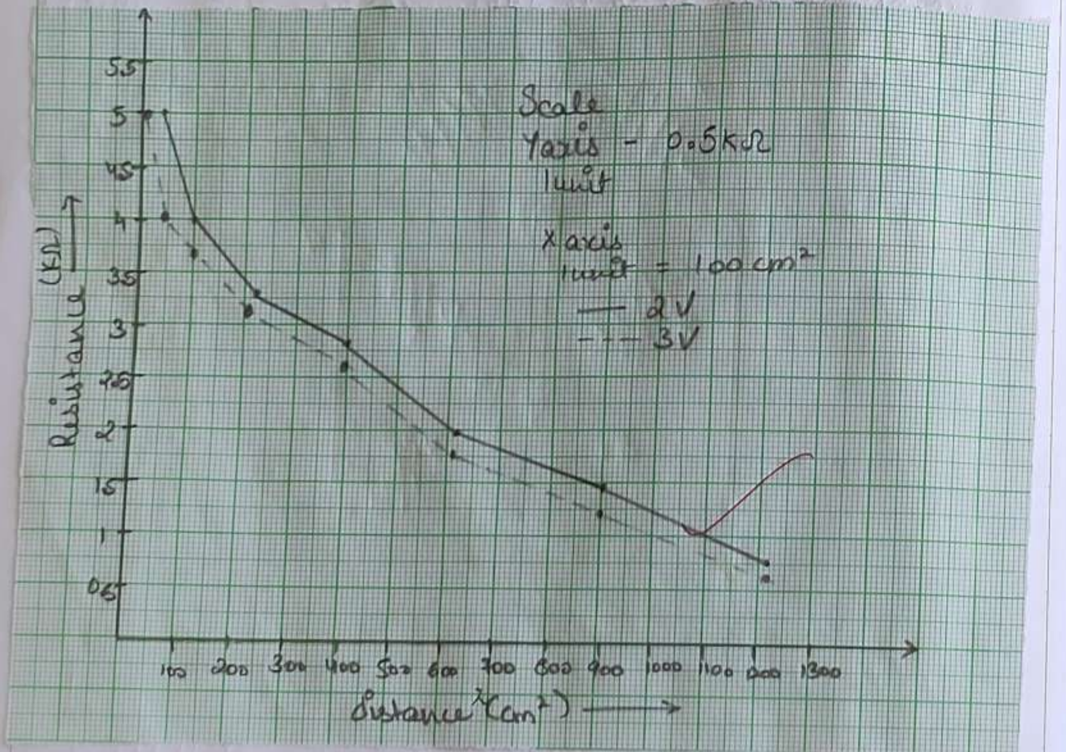
$R = \frac{3}{0.9} \times 10^3 = 3.33k\Omega$

$R = \frac{3}{1.1} \times 10^2 = 2.72k\Omega$

$R = \frac{3}{1.6} \times 10^3 = 1.875k\Omega$

$R = \frac{3}{2.3} \times 10^3 = 1.304k\Omega$

$R = \frac{3}{4.3} \times 10^3 = 0.697k\Omega$



EXPT. NO.	NAME:	Page No.:	YOUVA
		Date:	

3) Switch the instrument on using ON/Off switch and switch on the lamp also.

4) Adjust the power supply to 1V and focus on the light so that LDR gives recorded current. Note down the (mA) and (d)

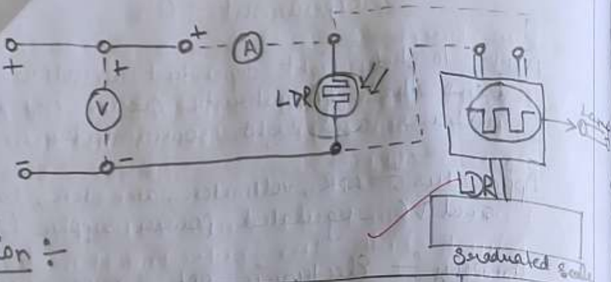
5) Calculate the resistance value of LDR using above formula

6) Vary the distance (d) between LDR and light source. Repeat 4 & 5 and note down the observation.

7) Plot the graph between resistance and distance

8) Also note down the current (mA) and observe ~~there~~ for fixed distance between LDR & light source for different voltage.

Teacher's Signature:



Observation :-

S.no	distance (cm) (2V)	Current (mA) (2V)	distance (cm) (3V)	(d^2)	Current (mA) (3V)
1	0	0.4	0	0	0.6
2	5	0.4	5	25	0.7
3	10	0.5	10	100	0.8
4	15	0.6	15	225	0.9
5	20	0.7	20	400	1.1
6	25	1	25	[illegible]	1.6
7	30	1.4	30	900	2.3
8	35	2.7	35	1225	4.3

$R = \frac{2}{0.4} \times 10^3 = 5K\Omega$

$R = \frac{2}{0.4} \times 10^3 = 5K\Omega$

$R = \frac{2}{0.5} \times 10^3 = 4K\Omega$

$R = \frac{2}{0.6} \times 10^3 = 3.3K\Omega$

$R = \frac{2}{0.7} \times 10^3 = 2.857$[illegible]

$R = 2K\Omega$

$\cancel{R = \frac{2}{1.4} \times 10^3} = 1.428K\Omega$

$R = \frac{2}{2.7} \times 10^3 = 0.74K\Omega$

EXPT. NO. NAME:

sizes and package styles. the most popular sizes has a face diameter of roughly 10mm.

LDR's are sensitive, inexpensive and redily avaliable devices. They have good power and voltage handling capacities similar to those of a conventional resistors. They take tens or hundreds of milliseconds to respond to the sudden changes in light and dark activated switches.

Formula :-

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

R = Resistance in Ohm (Ω)
V = Voltage in volt (V)
I = Current in amphere (A)

Procedure :- 1) Connect the DC power supply, volt meter and ammeter as shown in the circuit diagram.

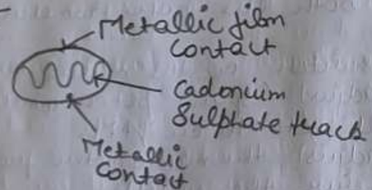
2) Place LDR and Lamp on a wooden plank opposite to each other.

Teacher's Signature

AIM:- To study light dependent resistors LDR and draw the charakyistics curve between the resistance and light source distance

Apparatus:- LDR, voltmeter, ammeter, lamp (60W) and DC regulated power supply (0-3V)

Diagram:-



Experiment - 04

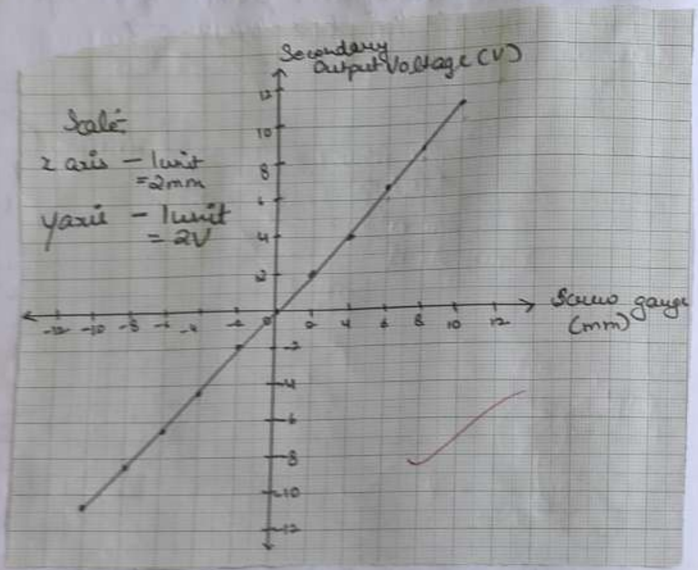
AIM:- To study light dependent resistors (LDR) and draw the characteristic curve between the resistance and light source distance.

Apparatus:- LDR, voltmeter, ammeter, lamp (60W) and DC regulated power supply (0-3V)

Theory:- Electronic opt sensor are devices that alter their electrical charateristic in the presence or absence of visible light. LDR operation relies on the fact that the conductivity resistance of a film of cadmium sulfide varies with the intensity of light falling on the face of the film. Under direction the resistance is very high whereas under bright condition the resistance is very low.

The device consist of a pair of metal film contract separated by a snake like track of CDS film, designed to provide maximum possible contact area with the two metal flies. The structure is housed in a clear plastic or resin case, to provide free access to external light. Practically LDR's are available in a variety of

Graph :-

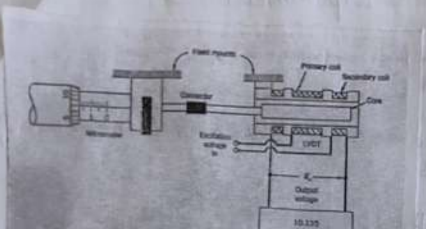


Procedure :-

1) Connect the circuit according to connection diagram
2) Connect the LVDT to the main trainer using 9 pin D connect.
3) First adjust the micro meter to zero
4) Adjust both the potentiometer to their max value.
5) Now switch on the mains
6) Now adjust (span) potentiometer so that we will get 10 on DPM.
7) Now adjust the micrometer from 0 to 20mm and observe the results.
8) Plot graph b/w mm and digital readout
9) There may be some residual voltage

Result :- Studied & observed the working of linear variable differential transformer

29/1



Observation table :-

S. No	Screw Gauge Displacement (mm)	Secondary output Volt (V)
1	2	2.1
2	4	4.3
3	6	6.6
4	8	8.8
5	10	11.0
6	−2	−2.1
7	−4	−4.3
8	−6	−6.4
9	−8	−8.4
10	−10	−10.5

EXPT NO. | NAME: | Page No.: | Date: | YOUVA

The O/p voltage will be the difference b/w the 2 voltage ($V_{S1} - V_{S2}$) as they are connected in series. Let us consider 3 different position of the soft iron core inside the transformer →

* NULL Position : This is also called the central position as the soft iron will remain in the exact center of the former. Thus the linking magnetic flux produced in the 2 secondary windings will be equal. Thus the resulting voltage $(V_{S1} - V_{S2}) = 0$

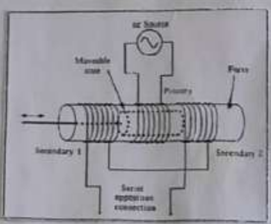
* Right of NULL Position : In this position, the linking flux at the winding S_2 has a value more than the linking flux at winding S_1. The O/p voltage $V_{S1} - V_{S2}$ will be in phase with V_{S2}

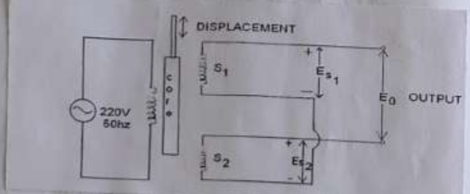
* Left of NULL Position : In this position the linking flux at the winding S_2 has a value more than the linking flux at the winding S_1. Thus, the result voltage $V_{S1} - V_{S2}$ will be in phase V_{S1}

From the working, it is clear that the difference in voltage $V_{S1} - V_{S2}$ will depend on the right or left shift of the core from the NULL Position. Also, the resulting voltage is in the phase with the primary voltage.

AIM:- To obtain the performance characteristic of linear voltage differential transformer

Apparatus:- Linear voltage differential transformer trainer





Experiment - 3

AIM:- To obtain the performance characteristic of linear variable differential transformer (LVDT)

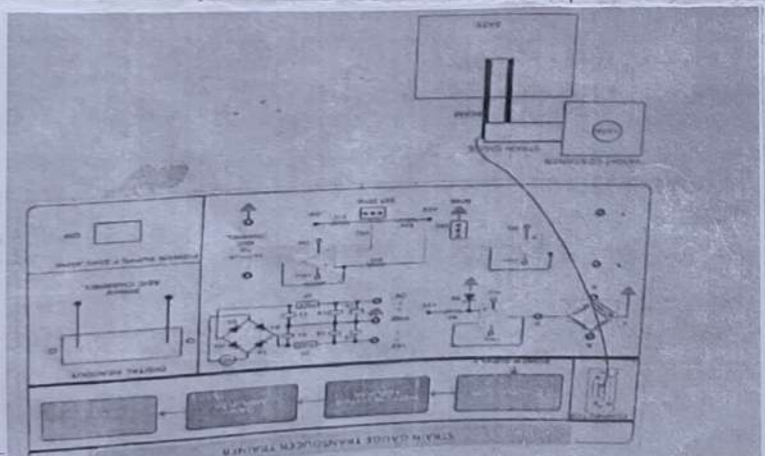
Apparatus:- Linear variable differential Voltage transformer trainer (LVDT)

Theory:- The Linear variable differential Voltage transformer is a type of electrical transformer used for measuring linear displacement. The LDTV converts a position or linear displacement from a mechanical reference (zero or NULL) into a proportional electric signal containing phase (for direction) and amplitude (for distance) information. The LVDT operation does not require any electric contact between the moving part and coil assembly, but instead relies on electromagnetic coupling.

The device consist of a primary winding (P) and 2 winding named S_1 and S_2. Both of them are wound on one cylinder former, side by side and they have equal number of turns. A moveable soft iron core is placed parallel to axis of the cylinder form. An arm is connected to the other end of the soft iron core and it moves according to the displacement produced.

Observation table :-

S.no	Weight / Load (gm)	Output Voltage (mV)
1	50	46
2	100	94
3	150	141
4	200	186
5	150	141
6	100	94
7	50	46



CIRCUIT DIAGRAM:

EXPT. NO. | NAME: | Page No.: | Date: | YOUVA

Thus to obtain a high resistance gauge occupying a small area, the metal chosen has a high resistivity, a large number of grid loops and a very small cross sectional area. The most a common material for strain gauge is a copper - nickel alloy known as advance.

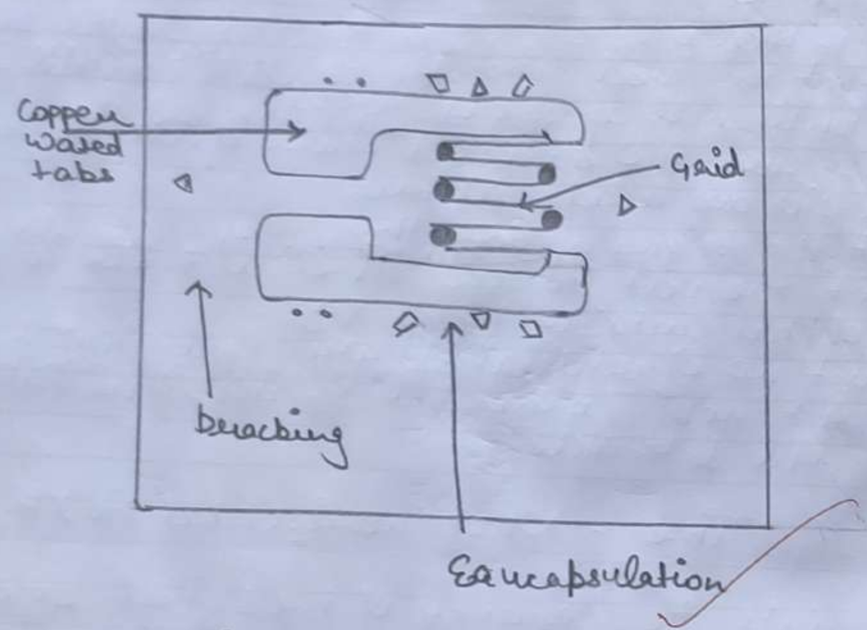
The strain gauge is connected to the material in which it is required to measure the strain with a thin coat of adhesive. Most common adhesive used is eastman, Deco Cement, etc as a the test specimen extends or contacts under stresses in the direction of windings.

Procedure :- 1) Connect the strain sensor using D type connector to the trainer
2) Switch on the trainer
3) Leave the module for 5 minute for warm up.
4) Connect the output from conditioning circuit to the digit meter provided on the panel.
5) After 5 minute put load on strain gauge and observed the gauge
6) Note down the results in the table.
7) Plot the graph between load and output voltage.

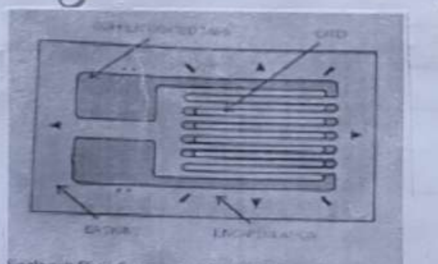
Teacher's Signature:

Aim:- To study the operation of stain gauge

Apparatus:- Stain gauge trainer, stain gauge



Single axis Stain gauge



Single axis Strain Gauge, approximately 10 times of actual size.

EXPT. NO.	NAME:	Page No.:	Date:

Experiment -02

AIM:- To study the operation of Stain Gauge

Apparatus:- Stain Gauge trainer, Stain Gauge

Theory:- A body subjected to external forces is in a condition of both stress and stain. Stress can be directly measured but its effect. If there is a relationship between stress and strain, stresses occurring in a body can be computed if sufficient Stain information is available. The constant connected the stress and stain in elastic material under the direct stresses is the modulus of elasticity

The principle of the electrical resistance load gauge was discovered by Lord Kevin, when he observed that a stress applied to a metal wire, besides changing resistance stain gauge are made into two basic form, bonded fire and bonded foil.

The resistance factor 'R' of a metal depends on its electrical resistivity ρ its area a and ρ length I. According to the equation $R = I/a$.

EXPT. NO.	NAME:	Page No.: Date:	YOUVA

→ Procedure

1) Turn on the oscilloscope
2) Adjust the intensity and focus of the trace
3) Use X and Y knobes to centre the trace horizonta and vertically.
4) Connect the cabel from CH_1 of the CRO to function
5) A signal will appear on screen
6) Make sure the inner red knobs of volt/Div and time/Div are locked clockwise.
7) Set the frequency to 100 Hz.
8) Adjust the volt/Div and time/Div knobe so that we obtain suitable signal size.
9) Count no of vertical square lying within sign
10) Count no of horizontal squares lying within the one duty cycle

Time = No of horizontal Div × time/Div

11) Calculate the frequency of the signal by using formula:-

$$Freq = \frac{1}{Time}$$

22/1

Teacher's Signature:

1 $\% \text{ Error} = \left|\frac{998-1000}{998}\right| \times 100\%$

$= 0.2\%$

2 $\% \text{ Error} = \left|\frac{2000-2000}{2000}\right| \times 100\%$

$= 0\%$

3 $\% \text{ Error} = \left|\frac{4030-4167}{4030}\right| \times 100\%$

$= 3.339\%$

4 $\% \text{ Error} = \left|\frac{5028-5000}{5028}\right| \times 100\%$

$= 0.558\%$

EXPT. NO.	NAME:	Page No.: / Date:	YOUVA

3) Swp Var knob :- Adjust the horizontal scale
4) Time / Div knob :- Controls the scale from 0.2 μs/ to 0.5 us/Div in 20 steps

→ Vertical Controls

1) Volt / Div knob :- Controls the CH_1 / CH_2 vertical scale
2) Vertical Position knob :- Controls the vertical positio
3) Vertical mode switch :- Switch CH_1 and CH_2
a) DVAL
b) ADD
4) CH_2 INV Switch :- Invert the CH_2 signals

→ Trigger controls

1) Trigger mode switch :- select Oscilloscope respond cond
1) Auto
2) Norm
3) TV-V
4) TV-H

→ Input terminal

1) CH_1(X) Input terminal - Accept the CH_1 input signal
2) AC / GND / DC Switch
a) AC - It block DC components including input signal
b) GND - show GND value in display
c) DC - It display all the input signal
3) GND terminal - Accepts the ground wire
4) CH_2 (X) terminal - Accept CH_2 input signal

Observation table

Sno	Verticle dimension	Unit/Div	Amplitude	Vrms
1	1	2V	2V	0.7071
2	2	2V	4V	1.4142
3	3	2V	6V	2.121
4	5	2V	10	3.535

S.no	Horizontal dimension	Time/Div	Time (ms)	Input freq (Hz)	Output
1	1	1	1	998	100
2	1	0.5	0.5	2000	2000
3	1.2	0.2	0.24	4030	4167
4	1	0.2	0.2	5028	500

Calculation :-

$$\% \text{ Error} = \left| \frac{\text{Actual} - \text{Experimental}}{\text{Actual}} \right| \times 100\%$$

EXPT. NO. NAME: Page No. Date: YOUVA

across the screen, repeats that at a certain frequency as the source of the signal. The voltage to be supplied to Y-plate. The combined sweep and Y voltage produces a graph showing variation of voltage with time.

Discription of CRO Features :-

→ Display control
1) CAL Output :- Generates a probe compenstion signal, positive square wave.
2) Intern Knob :- Controls the brightness of light spot.
3) Focus Knob :- Controls the focus of waveform
4) Trace rotation point :- Controls the alignment
5) Auto time base

→ LCD Display :-
1) CH_1 Verticle :- Shows the CH_1 verticle scale
2) Horizontal scale :- Shows the horizontal scale
3) X-Y mode :- When turned on, indicates X-Y
4) Signal Freq - Shows waveform frequency
5) CH_2 Vertical scale :- showed the CH_2 vertical scale.

→ Horizontal Controls :-
I) Horizontal Position knob - Controls horizontal position
II) X10 mag switch :- Magnify the horizontal scale by 10

Teacher's Signature:

AIM:- Familiarization with various component control of cathode Ray Oscilloscope

Objective :-

a) To get familiar with the use of different control switches of CRO

b) To visualise an AC signal, measure the amplitude and the frequency

Apparatus :- Cathode ray ~~oscilloscope~~ oscilloscope function generator

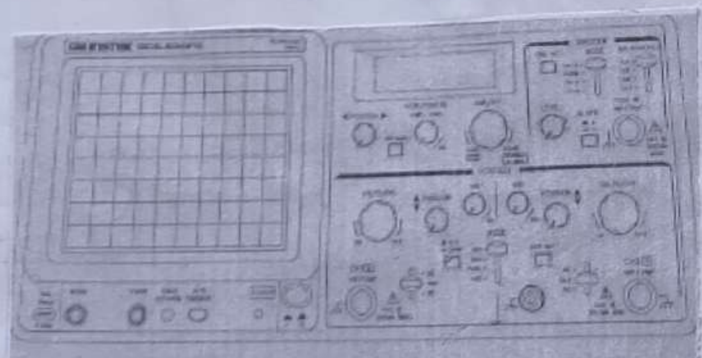


Fig. 1.1 Cathode Ray Oscilloscope (CRO)

EXPT. NO.	NAME:	Page No.: Date:	YOUVA

Experiment No-1

Aim:- Familiarization with various control of Cathode Ray Oscilloscope (CRO)

Objective :- i) To get familiar with the use of different control switches of CRO

ii) To visualise an AC signal, measure the amplitude and frequency.

Apparatus :- Cathode Ray Oscilloscope (CRO), function generator.

Theory :- CRO is one of the most widely used measuring devices in electronic and gives visual display of an input signal. This enables not only measurement of the quantity but also analysis and manipulation of its waveform. The device contains mainly of vaccum tube cointaing cathode anode, accelerates the emitted towards anode forming an e beam, which passes to fall on the screen. The grid which is situated b/w the electrodes, controls the no of e- passing through it controlling the intensity of e- beam. The X and Y plates are responsible for deflecting the e- beam horizontally and vertically. A sweep generator is connected to X plates which moves the bright spot horizontal