ELECTRICAL INSTRUMENTATION
LAB MANUAL(EE-508)

DEPARTMENT OF ELECTRICAL ENGINEERING

List of Experiments:

The following experiments are to be conducted with the help of Hardware and different Trainer of instrumentation System And Measuring Instruments etc

1. Study of characteristics of voltage to current conversion.
2. Study of characteristics of current to voltage conversion.
3. Study of characteristics of voltage to frequency conversion.
4. Study of characteristics of frequency to voltage conversion.
5. Study of characteristics for the measurement of displacement.
6. Study of characteristics of RVDTS & Linear variable Capacitor for the measurement of displacement.
7. Study of characteristics of Reflective Opto-sensor, Gray-coded disc and Ultrasonic Transmitter & Receiver.
8. Fluid Flow & level Measurements techniques using Electrical / Electro-mechanical transducer / sensors and their calibrations.
9. Study of Characteristics of Magnotostrctive sensor for the measurement of physical parameters/ quantity.
10. Hand on Practices on Programming PLC for the bi-directional rotation of a small incremental D.C. Motor.
11. . Hand on Practices on Programming PLC for sorting the Sizes of Metallic Pieces on a Moving Conveyor belt.

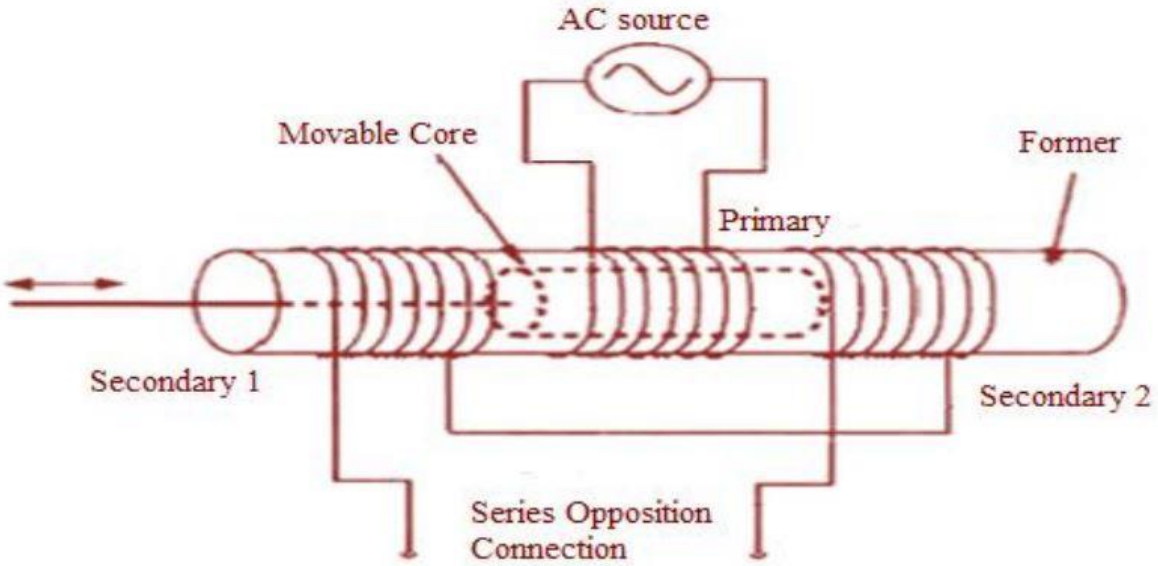
EXPERIMENT NO. 1

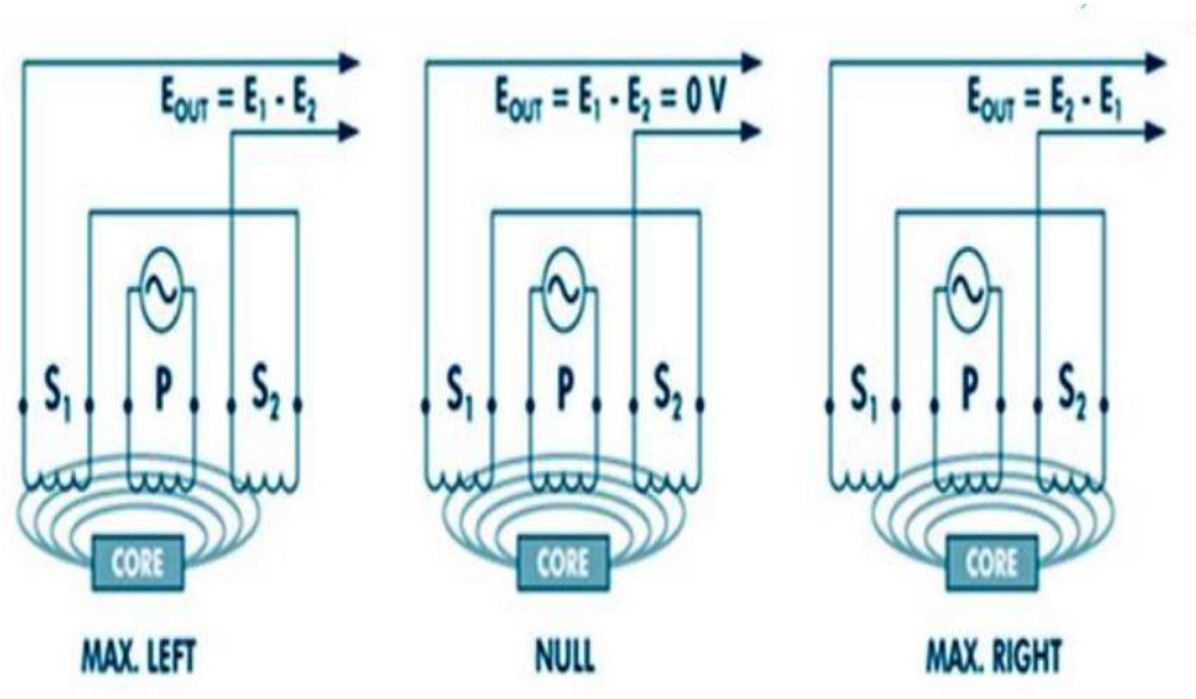
Objective: To study the Characteristics of LVDT.

Theory

One of the most variable inductive transducer is the differential transformer, which provides an ac voltage proportional to the displacement of the core passing through the windings. It is a mutual inductance device making use of three coils arranged generally on a single cylindrical concentric non-magnetic former. The control coil (primary) is energized from an external power source and the two end coils (secondary) connected in series opposition to each other, are used as a pickup coils. Output amplitude and phase depends on the relative coupling between the two secondary coils and the primary coil. Relative coupling between them is dependent on the position of the core. At null position the resultant voltage E0= E1-E2= 0 as E1=E2.Within the limits on either side of the null position, the output voltage magnitudes are ideally the same for equal core displacement the phase relation existing between power source and output changes 1800 through null. It is therefore possible through phase sensitive detector to distinguish between outputs resulting from either side of null. LVDT is a very widely used transducer for conversion of mechanical displacement into proportional electrical voltage, range from few microns to few tens of inches. It is free from temperature effects.

Circuit Diagram





Procedure

1. Connect the circuit according to circuit diagram.

2. Switch on the power supply.

3. The core is initially brought to null position.

4. First turn the nut in clockwise direction to move core inwards i.e. left of null position & take
respective voltage readings on the voltmeter.

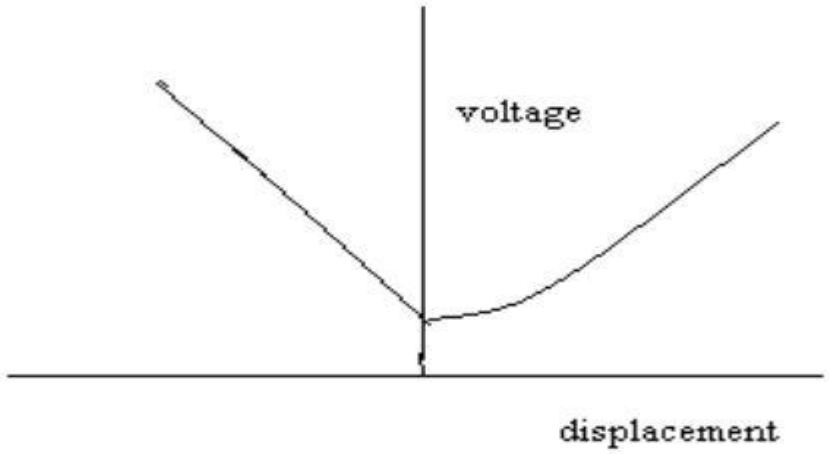
5. Now turn nut in anticlockwise direction to move the core towards right of null point & again take
respective voltage reading from voltmeter.

6. Plot the graph from the observations taken.

Observation table

S.No.	Displacement Micrometer (mm)	Displacement Reading (mm)	Analog o/p

Graph



RESULT: - Graph between voltage and displacement is plotted.

Experiment no.02

Practical Exercise for Characteristics of a Voltage to Current Converter

Voltage to Current Converter

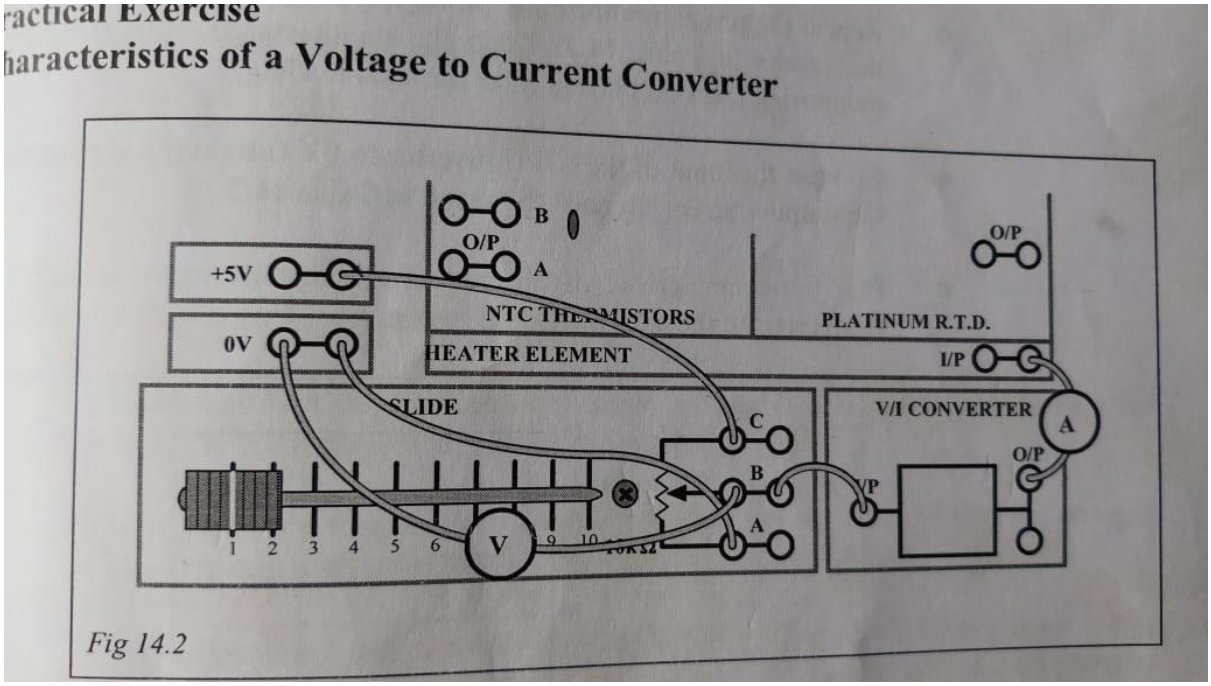
The voltage to current converter convert an input voltage to an output current. The device operates as a constant current source within the limit of the supply voltage. As an example of this , if 20mA is supplied to a load of 50 ohm, then the voltage dropped across the load is:
$20X10^{-3}X50=1.0V$

With the V/I converter supplied from +12V DC this is not problem. If, however, the load resistance is increased to 1 K ohm, the voltage across the load at 20mA would be:
$20X10^{-3}X1000=20V$
Which the device would be unable to provide from a+12V supply.

The main characteristics of the device fitted to the Dyna-1750 Trainer are:

Input voltage range	0-1.5V
Output current range(max.)	0-24mA
Transfer ratio	16mA/v

Circuit Diagram



Note that a second second meter is shown as an ammeter connected between the output of the V/I Converter and the load (the heater element on the thermal transducer panel). If a second instrument is available then the measurements will be simplied.

Procedure

1. Connect the circuit as shown in Fig. and set the 10 k-ohm resistor for zero output voltage (slider to left)

2. Switch on the power supply. Set the input voltage to the V/I converter to 0.5V.

3. Remove the digital multimeter from the circuit , range it as a ammeter (up to 25mA will be needed), and reconnect it in the output of the V/I Converter and the load. Measure the load current and record the result in the given table. Restore the digital multimeter as a voltmeter in the original as shown in the above fig.

4. Repeat the procedure for the input voltage settings of 1.0V and 1.5V and record the result in the table. Keep the multimeter connected as an ammeter monitoring the load current after the final reading.

5. Connect the input of the V/I Converter to 0V (ground) and note the effect on the output current and record the result on the table.

6. Plot the characteristics of the output current against the input voltage for the V/I converter on the axes provided.

Observation table

Input voltage	**0 V**	**0.5 V**	**1.0 V**	**1.5 V**
Output current	**mA**	**mA**	**mA**	**mA**

Experiment no.03

Practical Exercise for Characteristics of a Current to Voltage Converter

Current to Voltage Converter

The current to voltage converter converts an input current to an output voltage and is thus the converse of the voltage to current converter.

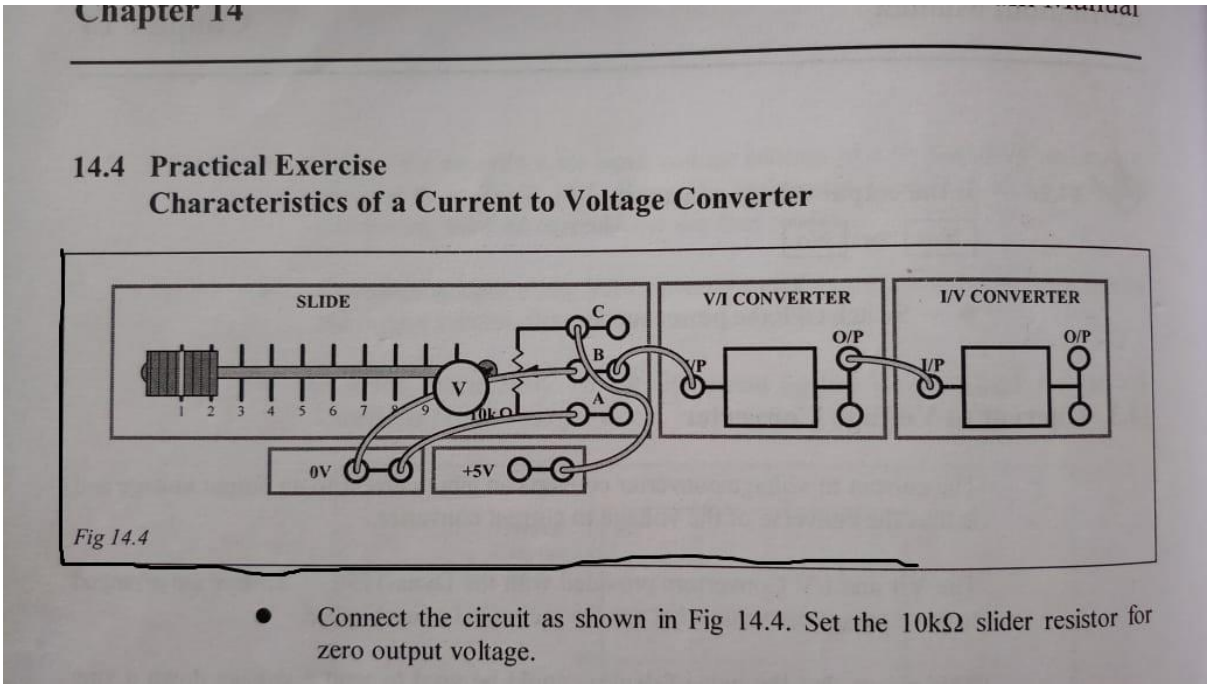
The V/I and I/V converter provided with the Dyna-1750 Trainer are arranged to have the parameter values that are the reciprocal of each other.

This means that the pair of devices could be used to send a voltage down a long wire without attenuation, since the current which is launched into the transmission line at one end must also appear at the termination.

The main characteristics of the I/V converter are:

Input current range	0-24mA(100mA max.)
Output voltage range	0-1.5V(6V max.)
Transfer ratio	62.5mV/mA

Circuit diagram



Procedure

1. Connect the circuit as shown in the above fig. Set the 10k-Ohm slider resistor for zero output voltage.

2. Switch ON the power supply.

3. Set the input voltage to the V/I converter to 0.5V. Transfer the digital multimeter to the output of the I/V converter and note the output voltage. Record the value in the below table.

4. Repeat the procedure for input voltage settings of 1.0 and 1.5V and enter the value in given table.

5. Transfer the input of the V/I converter to 0V(ground) and note and record the output voltage from the I/V Converter in the table.

Observation table

Input voltage(V/I)	0	0.5	1.0	1.5
Output voltage(I/V)	V	V	V	V

Experiment no.04

Practical Exercise for Characteristics of a Voltage to Frequency Converter

Voltage to Frequency Converter

This device converts an input voltage to an output frequency, the frequency being proportional to the input voltage.

The circuit is based on a dedicated (designed for the job) IC type LM331. The output waveform is in the form of short duration (approximate 60µs) negativegoing pulses, the repetition rate of which can be controlled over a wide range.

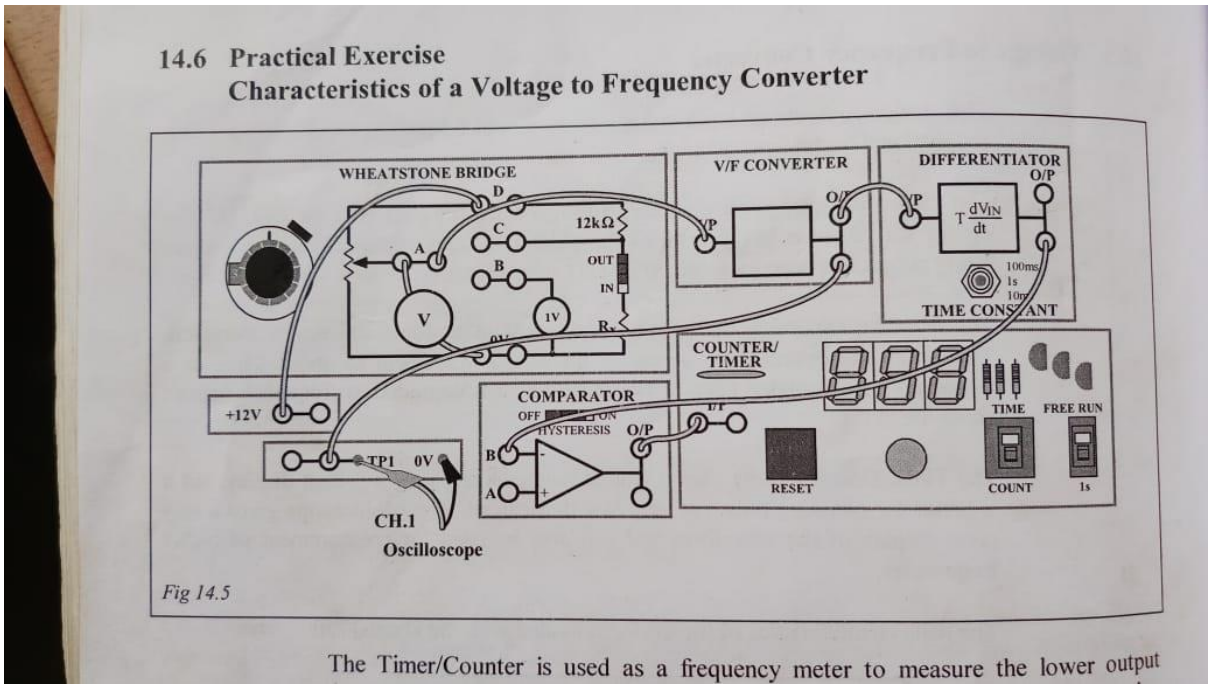
The negative excursion durations remain constant as the frequency is increased. This limit the overall time period of the output waveform to about 85µs, or a frequency of just under 12KHz. The pulse shape is degraded at frequencies above about 10.5KHz.

The timer/Counter facility has a limited range, having only a limited range, having only a3-digit display. but it is better for counting pulses at very low frequencies. The Oscilloscope gives a very good display of the waveform and can also be used for measurement of higher frequencies.

The main characteristics of the device provided with the Dyna-1750 are:

Type	LM331
Input voltage(max.)	12V
Transfer ratio	1KHz/V
Maximum frequency	10KHz
Non-linearity	0.024% full scale
Non-linearity(max.)	0.14%

Circuit diagram



The timer/Counter is used as a frequency meter to measure the lower output frequencies, within its range. The differentiator and comparator are pulse shaping circuits to enable the V/F Converter output to trigger the Timer/Counter.

An oscilloscope is used to monitor the output waveform and to determine frequencies above the range of the Timer/counter.

Procedure

1. Connect the circuit as shown in above fig. Set the Differentiator control to 1s, the Counter controls to COUNT and 1s, the comparator HYSTERESIS OFF and 10K-ohm 10-turn resistor to zero.

2. Switch ON the power supply and set the input voltage to 0.2V. Press the reset button of the counter and note the displayed value, which represents the frequency output of the V/F converter. Record the value in the table.

3. Repeat the procedure for input voltage settings of 0.4V,0.6V.0.8V and 1.0V recording the output frequency values in the table.

4. Plot the graph

Input voltage(volts)	0.2	0.4	0.6	0.8	1.0
Output frequency(Hz)					

Experiment no.05

Practical Exercise for Characteristics of a Frequency to Voltage Converter

Frequency to Voltage Converter

This device converts an input frequency to an output voltage.

Each input pulse triggers a monostable multivibrator to generate a constant period pulse which pumps one packet of charge into a reservoir capacitor. The voltage across the capacitor is therefore dependent on how many pulses are received each second.

For the unit provided with the DYNA-1750 Trainer, the parameters are arranged to be reciprocal to those of the V/I converter.

A communication channel would again be possible with frequency as the transmission medium.

The main characteristics are

Input frequency (max.)	10KHz
Transfer ratio	1V/KHz
Time constant	100ms
Settling time	0.7s
Accuracy	$\pm 0.1\%$
Output ripple	10mV
Output impedance	100K-ohm

Circuit diagram

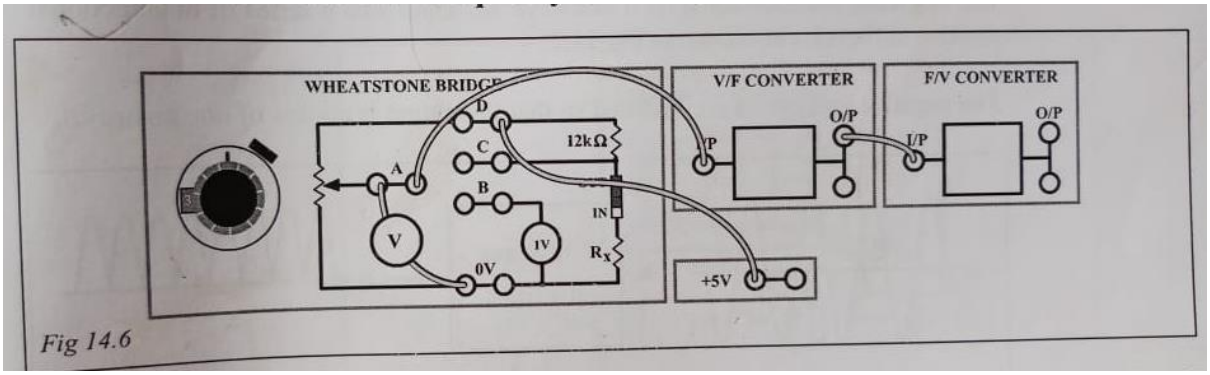


Fig 14.6

Procedure

1. Connect the circuit diagram as shown in the above fig. Switch ON the power supply and set the input voltage to the V/F converter to 1.0V. Note the value of the output from the F/V converter and record the value in the table.

2. repeat the procedure for the input voltage settings of 2,3,4,and 5V.

3. plot the graph

Input voltage(V/F)	1	2	3	4	5
Output voltage(F/V)	V	V	V	V	V