STUDY OF FORCE MEASUREMENT TRAINER,

(Using Strain Gauge Based Load Cells Transducer)

MODEL –F LC – 20.

OBJECT :

To study the performance characteristics of load cell.

DESCRIPTION :

Strain Gauge based Load Cell Measurement Trainer is designed for the students of Instrumentation Course. It allows the students to under stand the concept of Load Cell. Its application and its associated electronic circuits.

This Trainer Kit consists of :

1. Load Cell made of four banded metal strain gauges with arrangement to fix some load on it to generate the deformation.
2. Electronic circuitry alongwith a 3 ½ Digit Digital Voltmeter.

SPECIFICATIONS :

(i)	Load Cell	:	Strain Gauge Based.
	Measuring Range	:	0 – 5, Kg.
	Non – Linearity Error	:	± 1%.
	Resolution	:	0.01, Kg.
(ii)	Electronic Circuit		
	Excitation Source	:	DC Excitation (5, Volts)
	Amplifiers	:	Instrumentation Amplifier and Inverting Summing Amplifier with Zero and Gain adjustment.
	Termination	:	For 4 arm strain gauge bridge.
(iii)	Digital Voltmeter		
	Display	:	3 ½ Digit L.E.D. Display.
	Range	:	0 – 2,000, mVolt. F.S.

A toggle switch is provided to select the mV and Kg. Range.

POWER SUPPLY :

The kit has numbers of I.C. Regulated power supplies which are permanently connected to all the circuits. No external D.C. supply should be connected to the training kit.

Only 230 Volt, ± 10%, 50 Hz main supply is required to operated the training kit.

The schemiatic diagram in Fig. 1 shows the various builtin subsystems.

THEORY :

The Load Cell is an Electro – mechanical sensor employed to measure static and dynamic force. Load Cells can be designed to handle a wide range of operating forces with high level of reliability and hence its is one of the most popular transducer in industrial measurements.

The Load Cells derives it output from the deformation of an elastic member having high tensile strength. The basic design parameters includes relative size and shape material density and modulus of elasticity, strain sensitivity, deflection and dynamic response. Through a careful choice of the material and structural configuration. A linear relationship between a dimensional change and measured force can be achieved. The material so chosen should posses the following properties.

(i) Linear Stress Strain relationship up to a fairly large elastic strain limit.
(ii) Low Strain Hysteresis over repeated loading.
(iii) Very low creep over long periods of loading.
(iv) Very low plastic flow due to strain.

The most popular configurations of load cells are :
(i) Column – type.
(ii) Proving Ring Type.
(iii) Cantilever Beam Type.
(iv) Shear – Type.

In all the configuration deformation is sensed by the strain gauges. It is important that in all cases the strain gauge should be suitably located so that the output strain is linearly proportional to the input force with minimum Hysteresis and creep, high readability and overload capacity. Some of the configuration have excellent immunity to adverse side eccentric loads.

In all types of load cells, the stress developed due to force on loading is measured with four electrical strain gauges. All four strain gauges are connected to form a four arm active Wheatstone Bridge.

OPERATION :

1. Open the top cover of the trainer kit wooden box.
2. Connect the cantilever beam type load cell leads with the trainer kit terminals.
   Red lead with red terminal.
   Black lead with black terminal.
   Green lead with green terminal.
   Yellow lead with yellow terminal.
3. Connect the 3, pin mains plug of the training kit to the mains socket (230 Volt, ± 10%, 50 Hz supply)
4. Keep Digital Voltmeter switch at Kg. Position.

5. Connect patch cord between output terminal and digital voltmeter terminal.

6. Switch ON the trainer kit, the display will light up and will show some reading.

7. Adjust zero pot to set 0.00 reading on display without apply any load on the pan.

8. Put 1 Kgs. Weights on the pan of the cantilever beam and adjust span pot to show 1.00 reading on display.

9. Repeat steps 6 to 8.

10. Now apply loads in steps of 100 gms ad note down the reading in the following table in increasing and decreasing mode.

11. Now, plot the graph between applied load and Digital Voltmeter reading in Kgs. With a resolution of 0.01 Kg and applied load and measure non-=linearity, Hysteresis error etc.

TABLE – I

Sl.No.	Load increasing Mode		Load in Decreasing Mode.	
	Load (in Kg.)	DVM Reading (in mV)	Applied Load (in Kg.)	DVM (in mV)

INSTRUMENTATION AMPLIFIER OUTPUT MEASUREMENT :

12. Keep Digital Voltmeter at mV position.
13. Connect patch cord between instrumentation output terminal and Digital Voltmeter terminal.
14. At no load condition display will show reading. Note down this reading.
15. Apply load in steps of 100 gms. and note down readings in the given table in increasing and decreasing mode.
16. Now, plot the graph between applied load and Digital Voltmeter reading in Kgs. With a resolution of 0.01 Kg. and applied load and measure non-linearity, Hysteresis error etc.

TABLE – II

Sl.No.	Load increasing Mode		Load in Decreasing Mode.	
	Load (in Kg.)	DVM Reading (in mV)	Applied Load (in Kg.)	DVM (in mV)

OBSERVATIONS :

The result give below has been taken on prototype. The actual results may vary from unit to unit.

Load increasing Mode		
Load (in Kg.)	**Applied Load (in Kg.)**	**DVM Reading (in mV)**
.10	10	10
.30	.30	30
.50	.50	50
.70	.70	70
.90	.90	90
1.00	1.00	100

Load in Decreasing Mode.		
Load (in Kg.)	**Applied Load (in Kg.)**	**DVM Reading (in mV)**
1.00	1.00	100
.80	.80	80
.60	.60	60
.40	.40	40
.30	.30	30
.10	.10	10