TORQUE MEASUREMENT TRAINER,

MODEL – TM – 10.

OBJECT

To study the performance characteristics of a Torque Transducer.

INTRODUCTION :

The training kit for Torque Measurement Trainer, Model – TM – 10 is specifically designed for the study of strain gauge based torque transducer in static mode with its associate electronic signal conditioners etc.

This trainer kit consists of :

(i) Strain Gauge based Torque Transducer.
(ii) Electronic circuitry with 3 ½ digit Digital Voltmeter.
(iii) Suitable mechanism to apply the torque in static mode.

SPECIFICATIONS :

(i)	Torque Transducer	:	Strain Gauge based.
	Measuring Range	:	0 – 2.5 Newton meter.
	Non – Linearity errors	:	± 1%.
(ii)	Signal Conditioner Excitation Source	:	D.C. Excitation (5 volts).
	Amplifier	:	Differential (Instrumentation) Amplifier With adder and zero adjustment.
	Working Temperature	:	0 – 50^0C.
(iii)	Digital Voltmeter Display	:	3 ½ Digit L.E.D.
	Range	:	0 – 2000, mVolt.

Power Supply :

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

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

THEORY :

The Torque is the tangential force required to set a body into rotation. It is represented as moment vector of a force.

For a rigid body undergoing free rotation about a single axis, the

Torque $T = I\alpha$.

Where I is the moment of inertia of the body about that axis

and α is the angular acceleration.

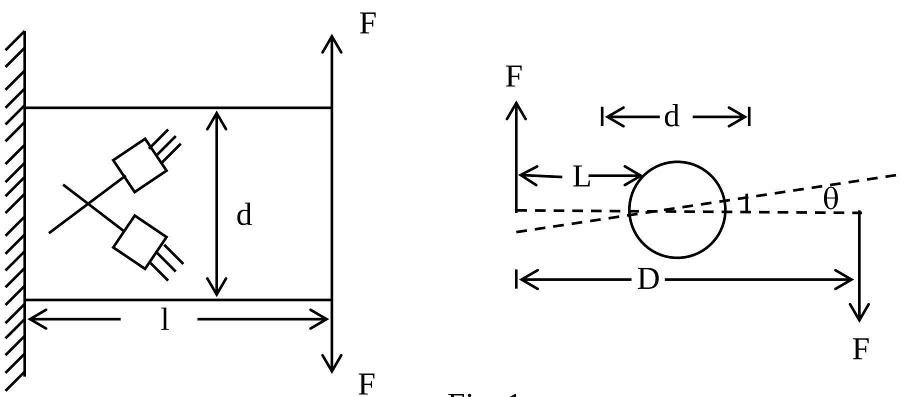

Fig. 1.

For the measurement of torsional shear strain one can take the advantage of the fact that shear in a plane normal to the axis of the shaft accompanied by tensional and compressional at strain at $\pm 45^0$ to the axis as shown in the Fig. 1.

From the Fig.

$$\text{Angular deflection } \theta = \frac{32 \; FDL}{\pi d^4 G} \qquad (1)$$

since Torque T = F x D. (Newton meter)

$$\text{hence,} \quad \theta = \frac{32 \; TL}{\pi d^4 G} \qquad (2)$$

when G is the modulus of rigidity (10^9 N/m^2), and

$$\text{The maximum stress } \sigma = \frac{16 \; T}{\pi d^3} \quad N/m2 \qquad (3)$$

In the experimental set – up.

d	=	12.0, mm	=	0.012 meter.
D	=	250, mm	=	0.25 Meter.

F = Maximum 1 Kg f. (x 9.90665 Newton = 9.90665 Newton)

T = F x D (N – m) = 9.90665 x 0.25 = 2.4766625N – m

Using eq. (3) $\sigma = 7.2995015 \times 10^6$ N/m^2

Hence Strain (ε) = σ/E = $7.2995015 \times 10^6/210 \times 10^9$……………………………(4)

= 34.7595×10^{-6} µS

Similarly we can obtain, Strain at different values of applied load (Torque)

CALIBRATION TABLE FOR TORQUE TRANSDUCER :

T = F x D (N – m)

TABLE – I

S. No	Force in Kg	Torque in N - m
1.	0.1	0.25
2.	0.2	0.49
3.	0.3	0.74
4.	0.4	0.99
5.	0.5	1.24
6.	0.6	1.48
7.	0.7	1.73
8.	0.8	1.98
9.	0.9	2.23
10	1.0	2.48

4. OPERATION :

1. Connect the Torque Transducer with the training kit terminals.
   Red Lead with red terminal.
   Black Lead with black terminal.
   Green Lead with Green terminal.
   Yellow lead with yellow terminal.

2. Connect output terminal to the Digital Voltmeter with patch cords.

3. Connect the 3 pin mains plug of the kit to the mains socket (230V ± 10%, 50 Hz Power Supply).

4. Switch ON the training kit, the display will light up and will show some reading.

5. Keep µs/N M Switch to µs position.

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

7. Now apply 1 kg weight on the pan.

8. Adjust adder to show display reading 35 μs.

9. Repeat step 5 to 7.

10. Now apply loads in step of 0.1 Kg (100 gms) and note down the reading in the given table 2.

TABLE – II.

S. No.	Torque in increasing mode		Torque in decreasing mode	
	Force in kg	DVM in μs	Force in kg	DVM in μs

11. From this table one can calculate the non linearity hysteresis error etc. by comparing these readings with the theoretically calculated reading from table 1.