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Experiment No : 1

Title :- Water level measurement using water level measurement tube

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Aim :- Measurement of water level using Sensor

Theory :-

The new Tech instruments kit is meant for measurement of water level through water level transducer. The circuit diagram is given on the top cover on the kits to understand the measurement parameter at glance. All the different test points are also provided on the top cover with giving their reading etc facilities the students to understand without any operation instruction by any third person.

While performing the experiments, there are good chances of encountering errors, errors defined as difference between true values and calculated value. These errors can be of various types, like Errors, errors, which occur due to human mistakes. Systematic Errors which occur either due to Instruments mishandling, defects in instruments, etc. Apart from this, environment errors can take place.

Besides errors reduction, there is a term named sensitivity. It is defined as change in the output of sensor per unit change in the parameter being measured. Sensitivity depends on a number of variable factors. The mechanical properties of a transducer

may vary with temperature. and cause a variation in sensitivity, but it's the electrical part which is responsible for greatest changes. High sensitivity of measuring element increases the chances of a quick response

Mathematical formulation :-

i) Error :-

Error = (Measured Value - Actual Value)

Error % = $\frac{\text{Error}}{\text{Actual Value}} \times 100$

= $\frac{\text{Measurement} - \text{Actual Value}}{\text{Actual value}} \times 100$

ii) Sensitivity (slope of calibration curve graph) :-

Sensitivity = $\frac{\Delta O_0}{\Delta I_0}$ where ΔO_0 is Infinitesimal change in output

ΔI_0 is infinitesimal change in input.

iii. Mean Deviation, Deviation, Maximum Deviation, Standard Deviation:

Mean Deviation (y_{mean}) $= \frac{\sum_i^n y_i}{n}$

Deviation (d) $= y_n - y_{mean}$

Maximum Deviation $= \max(\sum y_n)$

Standard Deviation $S = \sqrt{\frac{\sum d^2}{n}}$ where, d is individual deviation & n is the number of readings

iv Observation Table:

S.No.	Water Level Transducer (mm)	Indicator reading		Analog O/P in Volts DC		Error %	
		Forward	Backward	Forward	Backward	Forward in	Backward in
1	0	0	0	0	0.001	0	0
2	10	10.5	9.9	0.04	0.03	5.00	1.00
3	20	20	20.1	0.17	0.26	0	0.5
4	30	29.8	30.2	0.37	0.40	0.67	0.67
5	40	40.1	40.1	0.61	0.65	0.25	0.25
6	50	50.2	50.1	0.95	0.92	0.4	0.20
7	60	59.7	59.8	1.21	1.19	0.5	0.33
8	70	70.0	70.7	1.57	1.54	0	0.42
9	80	80.5	80.1	1.63	1.63	0.38	0.16
10	90	89.7	99.9	1.85	1.83	0.33	0.11
11	100	100.5	99.1	2.03	2.00	0.10	0.90

Calculation :-

y_{mean} (forward) = 50.05

y_{mean} (Backward) = 49.96

Deviation :-

For Forward Indicator Readings :-

$d_1 = 50.05$
$d_2 = 39.85$
$d_3 = 30.05$
$d_4 = 20.25$
$d_5 = 9.95$
$d_6 = 0.15$
$d_7 = 9.65$
$d_8 = 19.95$
$d_9 = 30.25$
$d_{10} = 39.85$
$d_{11} = 50.25$

For Backward Indicator Readings :-

$d_1 = 49.96$

$d_2 = 40.06$

$d_3 = 29.86$

$d_4 = 19.76$

$d_5 = 9.86$

$d_6 = 0.13$

$d_7 = 9.83$

$d_8 = 20.34$

$d_9 = 30.14$

$d_{10} = 39.94$

$d_{11} = 49.14$

Standard deviation :-

For forward Indicator Reading :- $S = 27.29$

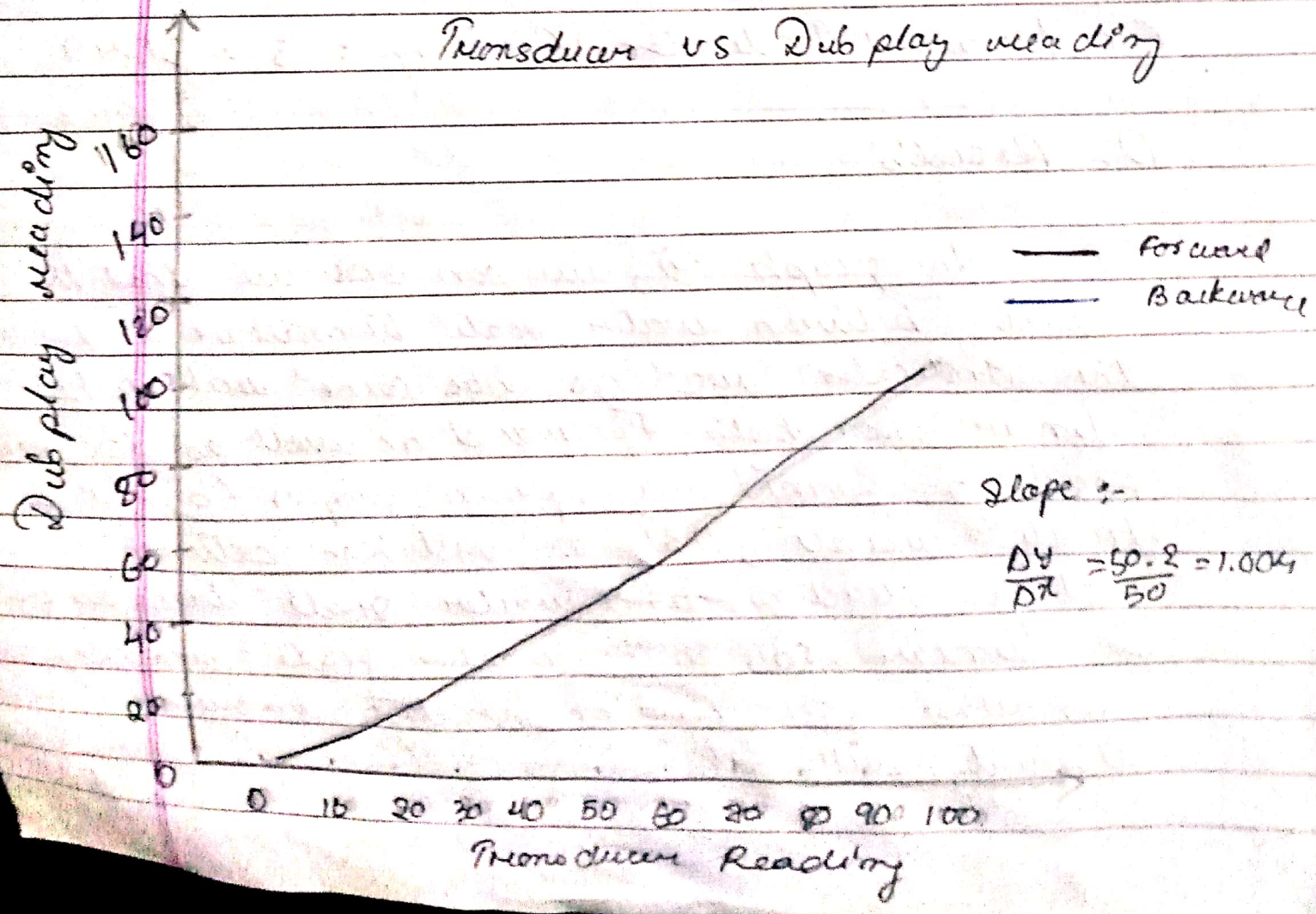
For forward Indicator Reading :- $S = 31.49$

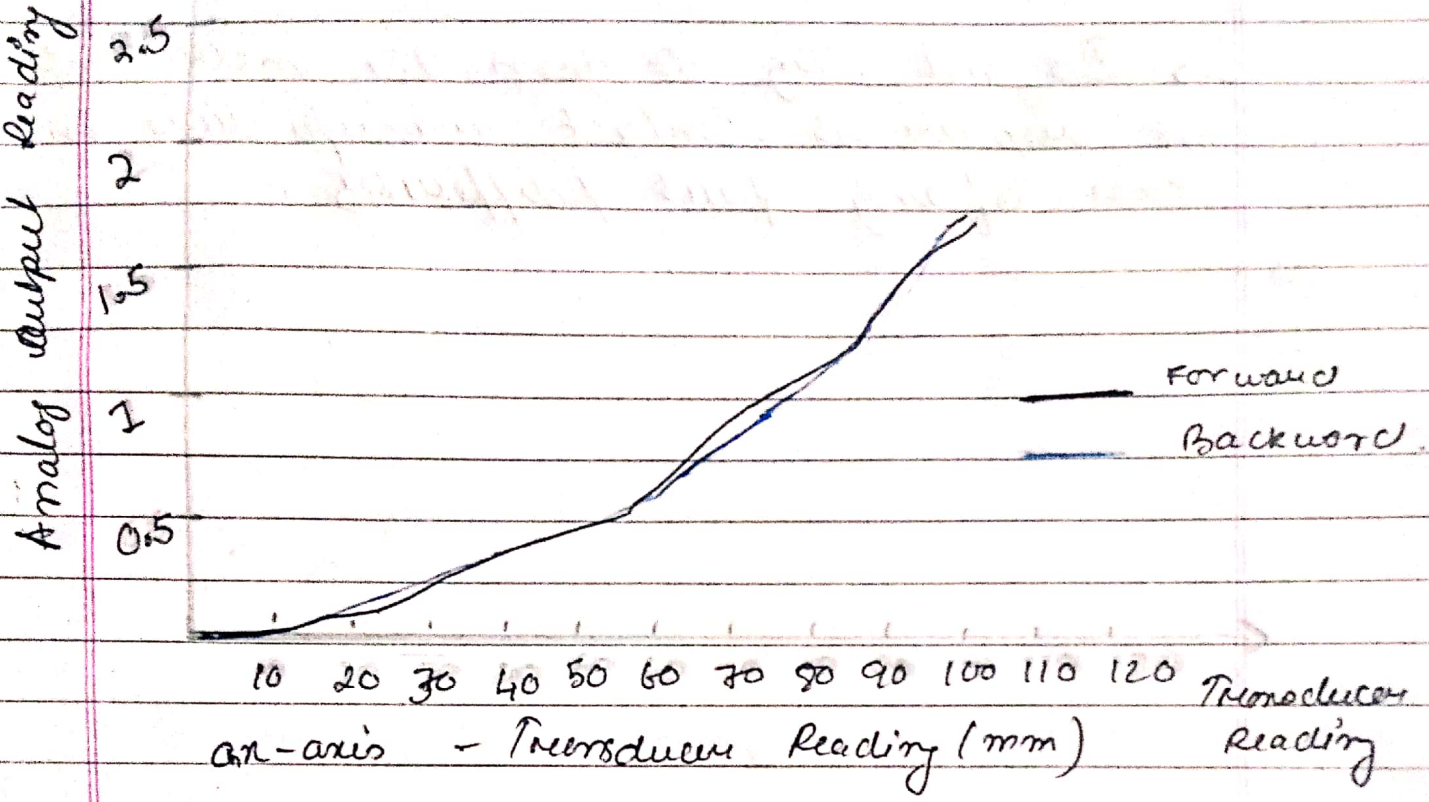
D. Results

From the graph ⓐ, we can observe that the curve between water scale transducer and the Indicator readings has come out to be linear, for both Forward as well as Backward Readings. Similarly, from graph (b). it is clearly visible, that the relation between voltage reading and water scale transducer is linear. So, as the water scale reading increase, the Analog voltage increase linearly with it.

Conclusion :-

As we see the use of LVDT, can help us to determine water levels at various output analog voltages. This technique can help in determing water levels, which in turn can help to prevent water losses at various places, in industries. Also, the various percentage recorded in experiment is low which shows, This is an accurate method and hence can be quite beneficial. Along with this fact, the linear relations is quite clearly shown via the graph, hence, it proves its name clearly.





On x-axis - Transducer Reading (mm)

On y-axis - Analog Output (V); Black - Forward.
Blue - Backword

$$\text{Slope} = \frac{\Delta y}{\Delta x} = \frac{0.65}{40} = 0.016$$

Precautions:

→ To get good performance from the sensor you have to maintain room temperature.

→ To check the power source, it should be 230 V ± 10%, 50 Hz to avoid over voltage hazards

→ To get best performance, you have to put the instrument at dust proof and

humidity free environment.

→ Do not try to open the instrument or repair it. Contact manufacturer in case of any fault / difficulty.