EXPERIMENT -11

CALIBRATION OF CAPACITIVE TRANSDUCER FOR ANGULAR DISPLACEMENT

Aim:

To calibrate capacitive transducer for angular displacement.

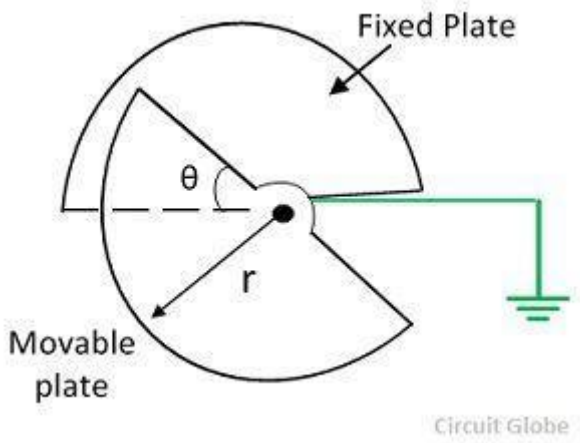
Apparatus:

Capacitive transducer & Angular displacement indicator

Theory:

Capacitance is well known to be a function of effective area of the conductors, separation between them ,and the dielectric strength of the material in the separation. Capacitive transducers convert the physical quantity to be measured in to a change of capacitance which is processed by them ensuring circuit of the transducer. The capacitance of

A parallel plate capacitor may be changed by varying the separation between the plates, varying the effective area of the plates or varying the dielectric. The over lapping area between two stator and rotor plates of the capacitor goes on changing gas the shaft capacitor is rotated. The arrangement is used to demonstrate the measurement of angular displacement.



Principle:

The capacitive transducer works on the principle of change in capacitance due to change in overlapping area of plates can be used for angular displacement measurement. The capacitance of a parallel plate capacitor which is given by

$C = \epsilon . A/d$

where C = Capacitance of a capacitor in Farads)

$\epsilon = \epsilon_r \epsilon_o$

ϵ = Permittivity of the dielectric medium (F/m)

A= Area of plates or electrodes. (m^2) ϵ_r = Relative permittivity (dielectric constant)

ϵ_o= Permittivity of free space ($8.54*10^{-12}$ F/m) d = Distance between two plates (m)

The change in overlapping area of rotating parallel plates is considered for measuring angular displacement.

specification:

Sensor :	: Angular plate capacitor
Sensor Material	: Aluminum plates
Dielectric Medium	: Air
Displacement	: 0 to 90 ^{0}
Accuracy	: 5 to10%
Power	: 230V +/- 10% 50HZ

Procedure:

1. Connect the capacitive pick-up to the input socket o the front panel of the instrument tutor.
2. Allow the instrument in On position for 10 minutes for initial warm-up
3. Move the moving plate to Zero position.
4. Adjust the ZERO potentiometer so that the display reads‘000’
5. Now turn the shaft of the capacitive pick-up to full clockwise position gently till the scale reading is 170^0. Adjust the meter reading to 170^0 by operating the CAL POT.
6. Turn the shaft of the capacitive pick-up full clockwise position in a gentle manner in step of 5 to 10^0 for angular sensor and note down the reading in the tabular column till 170^0
7. A known displacement is given to the parallel plate and note down the readings corresponding to input angular displacement and indicated angular displacement on the digital meter in the following observation table.
8. Plot the input and output readings on the x and y axis of a graph.
9. Repeatability can be calculated by repeating the experiment 3 to 4 times and tabulating the readings both for ascending and descending of angular displacement.

Tabular column:

Sno	Angular displacement protractor reading (Ra in Degrees)	Measured Displacement reading $(Rm)_0$ (degrees)	Error (Rm–Ra) (degrees)	Correction (Ra– Rm) (degrees)	Absolute %Error [(Rm -Ra)/ Rm]*100
1					
2	30_0	31_0	1_0	-1_0	0.58 %
3					
4					
5					
6					

Specimen calculation:

Considering the second observation, the specimen calculations are as follows. Angular displacement protractor reading, Ra= 30^0

Measured angular displacement reading using digital indicator ,Rm = 31^0

Error =Rm–Ra = $31^0 - 30^0 = 1^0$

Correction = -(error) = Ra– Rm = 30 - 31 = -1^0

Absolute %Error = [(Rm -Ra)/Rm]*100 = [(31- 30)/31]*100 = 3.2 %

Graph:

Plot a graph using the true angular displacement on X axis & measured angular displacement on Yaxis . Accuracy and the linearity of the capacitance sensor can be calculated by the graphs,

Result: