DEPT. OF ELECTRICAL & ELECTRONICS ENGINEERING
SRM INSTITUTE OF SCIENCE AND TECHNOLOGY, Kattankulathur – 603203.

Title of Experiment	: **11. Displacement measurement using LVDT and pressure measurement using Strain gauge**
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Register Number	: RA2111050010001
Date of Experiment	:14-12-2021
Date of submission	**:** 15-12-2021

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
Total		**50**	

Staff Signature

Experiment No. 11 Date :	Displacement measurement using Linear Variable Differential Transformer

Aim: To measure the displacement and to determine the characteristics of LVDT (Linear Variable Differential Transformer).

Apparatus required: LVDT, Digital displacement indicator, Calibration jig (with micrometre).

THEORY: LVDT (LINEAR VARIABLE DIFFERENTIAL TRANSFORMER)

The most widely used inductive transducer to translate the linear motion into electrical signals is the linear variable differential transformer (LVDT). The basic construction of LVDT is shown in Figure 1.

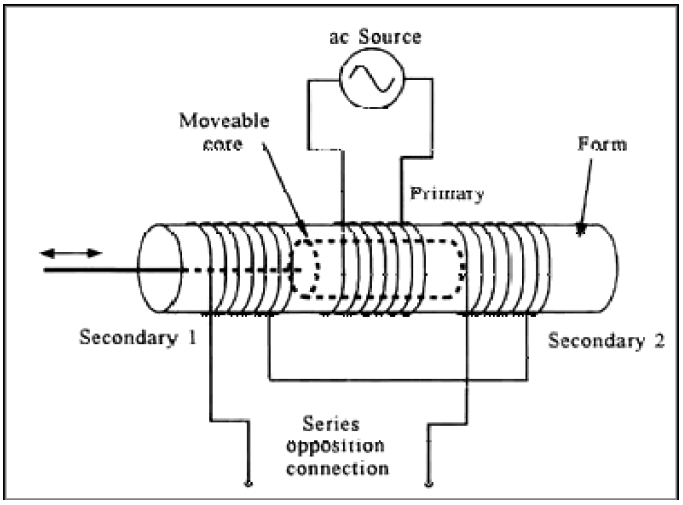


Figure 1. Linear Variable Differential Transformer

The transformer consists of a single primary P and two secondary windings S1 and S2 wound on a cylindrical former. The secondary windings have equal number of turns and are identically placed on either side. A moveable soft iron core is placed inside the transformer. The displacement to be measured is applied to the arm attached to the soft iron core. In practice the arm is made of highly permeability, nickel iron which is hydrogen annealed. This

gives low harmonics low null voltage and high sensitivity. This is slotted longitudinally to reduce eddy current losses. The assembly is placed in stainless steel housing and the end leads provides electrostatic and electromagnetic shielding. The frequency of AC applied to primary windings may be between 50 Hz to 20 kHz. Since the primary winding is excited by an alternating source, it produces an alternating magnetic field which in turn induces alternating current voltage in the two secondary windings. Figure 2 depicts a cross-sectional view of an LVDT. The core causes the magnetic field generated by the primary winding to be coupled to the secondary. When the core is centred perfectly between both secondary and the primary as shown, the voltage induced in each secondary is equal in amplitude and 180 degree out of phase. Thus the LVDT output (for the series-opposed connection shown in this case) is zero because the voltage cancels each other. E0 = Es1 - Es2 = 0.

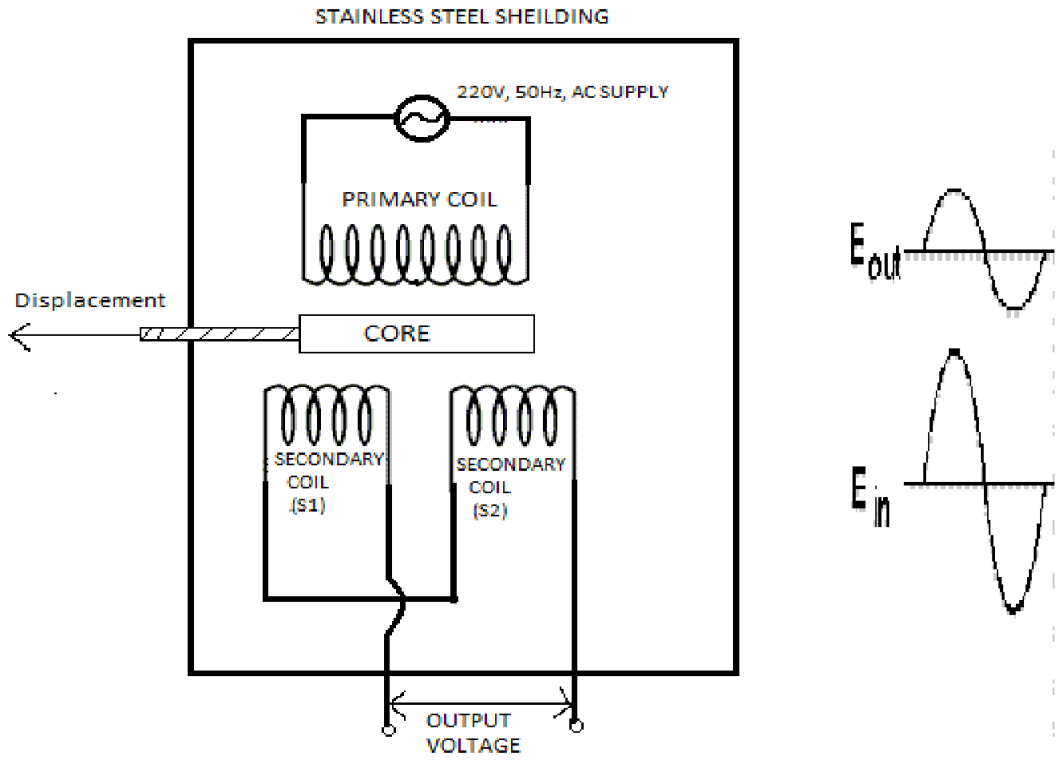


Figure 2. View of LVDT Core and Windings

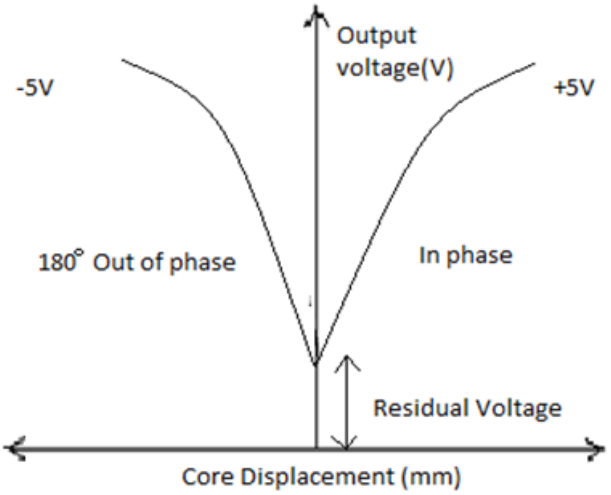
Displacing the core to the left causes the first secondary to be more strongly coupled to the primary than the second secondary. The resulting higher voltage of the first secondary in relation to the second secondary causes an output voltage that is in phase with the primary voltage. Likewise, displacing the core to the right causes the second secondary to be more

strongly coupled to the primary than the first secondary. The greater voltage of the second secondary causes an output voltage to be out of phase with the primary voltage.

Procedure:

1. Plug power chord to AC mains 230 V, 50 Hz and switch on the instrument.
2. Place the READ/CAL switch at READ position.
3. Balance the amplifier with the help of zero knob so that display should read zero without connecting the LVDT to instrument.
4. Replace the READ/CAL switch at CAL position.
5. Adjust the calibration point by rotating CAL knob so display should read 10.00 i.e., maximum calibration range.
6. Again keep the READ/CAL switch at READ position and connect the LVDT cable to instrument.
7. Make mechanical zero by rotating the micrometre. Display will read (00.00) this is null balancing.
8. Give displacement with micrometre and observe the digital readings.
9. Plot the graph of micrometre reading v/s digital reading.

Model Graph:



Result:
We are able to find the secondary output for the given core displacement of the circuit given.

POST LAB QUESTIONS:

1. What are the three principles of Inductive transducers?
The three principles of the inductive transducer are :-

1. Self inductance change
2. mutual inductance change
3. Eddy Current production

2. What are the limitations of LVDT?
The limitations of LVDT are :-

1. Large displacements are required for appreciable differentiation output.
2. They are sensitive to stray magnetic fields.
3. Dynamic response is limited.
4. temperature also affects the transducers.

3. Where is LVDT used?
the use cases of LVDT are as follows :-

1. position feedback in servomechanisms.
2. automated measurement in machine tools and many other industrial and scientific applications.
3. measurements of displacements ranging from fraction of mm to cm.
4. acting as a secondary transducer, it can be used for force, weight and pressure measurement.

4. What are the different types of transducers used for displacement measurement?
Types of LVDT based on applications :-

1. general purposes LVDT
2. precision LVDT
3. submersible LVDT

Types of LVDT based on range operation

1. Short stroked
2. long stroked

Types of LVDT based on excitation used

1. AC LVDT
2. DC LVDT

Types of LVDT based on armature:

1. unguided armature
2. guided armature
3. spring extended armature

5. What is the difference between variable resistance & variable inductance displacement transducer?

Variable resistance displacement transducer :

The transducer whose resistance varies because of the environmental effects of such types of transducer is known as variable resistance transducer. The change in resistance is measured in physical quantities like temperature, displacements, vibrations etc.

Variable inductance displacements transducer:

Variable inductance displacement transducer or inductive transducer work on the principle of inductance change due to any appreciable change in the quantity to be measured for example LVDT a kind of inductive transducer, measures displacements in term of voltage differences between its two secondary voltages. Inductive transducers find applications in proximity sensors which are used for position measurement, dynamic motion measurements, touch pads etc.