



**Measurement and**  
**Instrumentation Laboratory**  
**(EE3P005)**

**EXPERIMENT-9**

**Piezoelectric Transducer**

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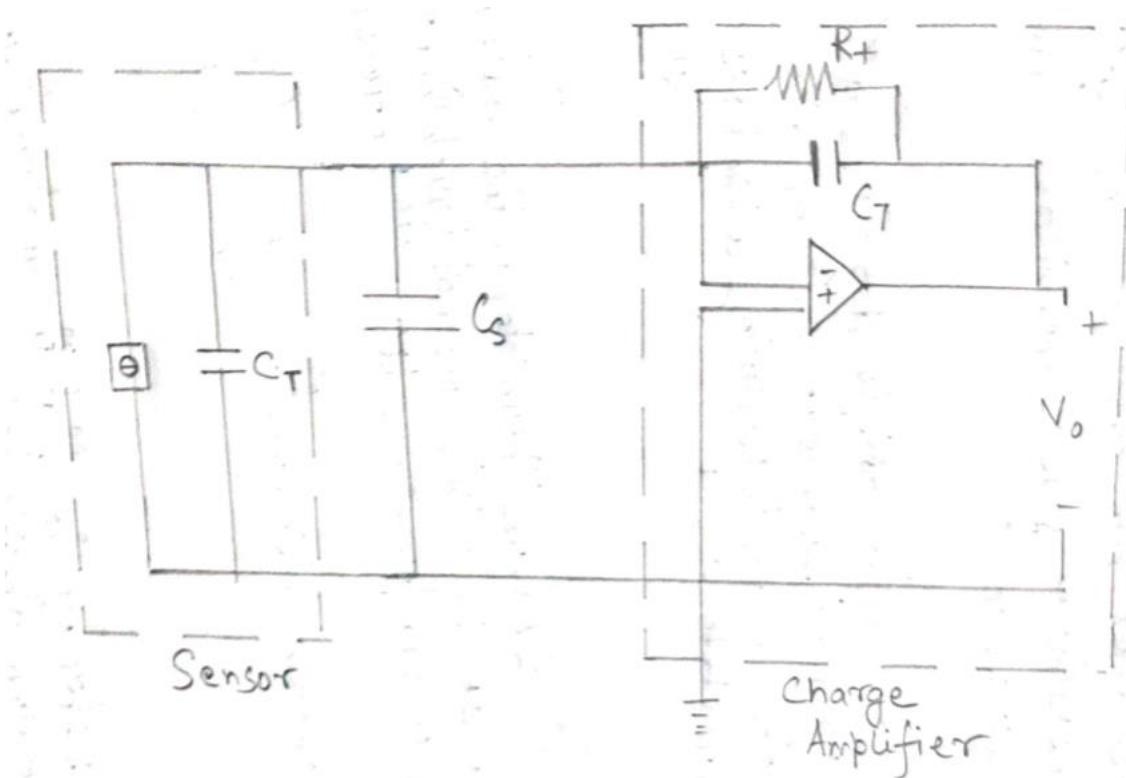
## **AIM OF THE EXPERIMENT:**

Study the working of a piezoelectric transducer by measuring the change in force when a weight is suddenly dropped and then converting change to an electrical charge.

## **APPARATUS REQUIRED:**

1. Piezoelectric Transducer Trainer
2. Visiting Card
3. Marble
4. Digital Multimeter
5. Acrylic Table with Slots

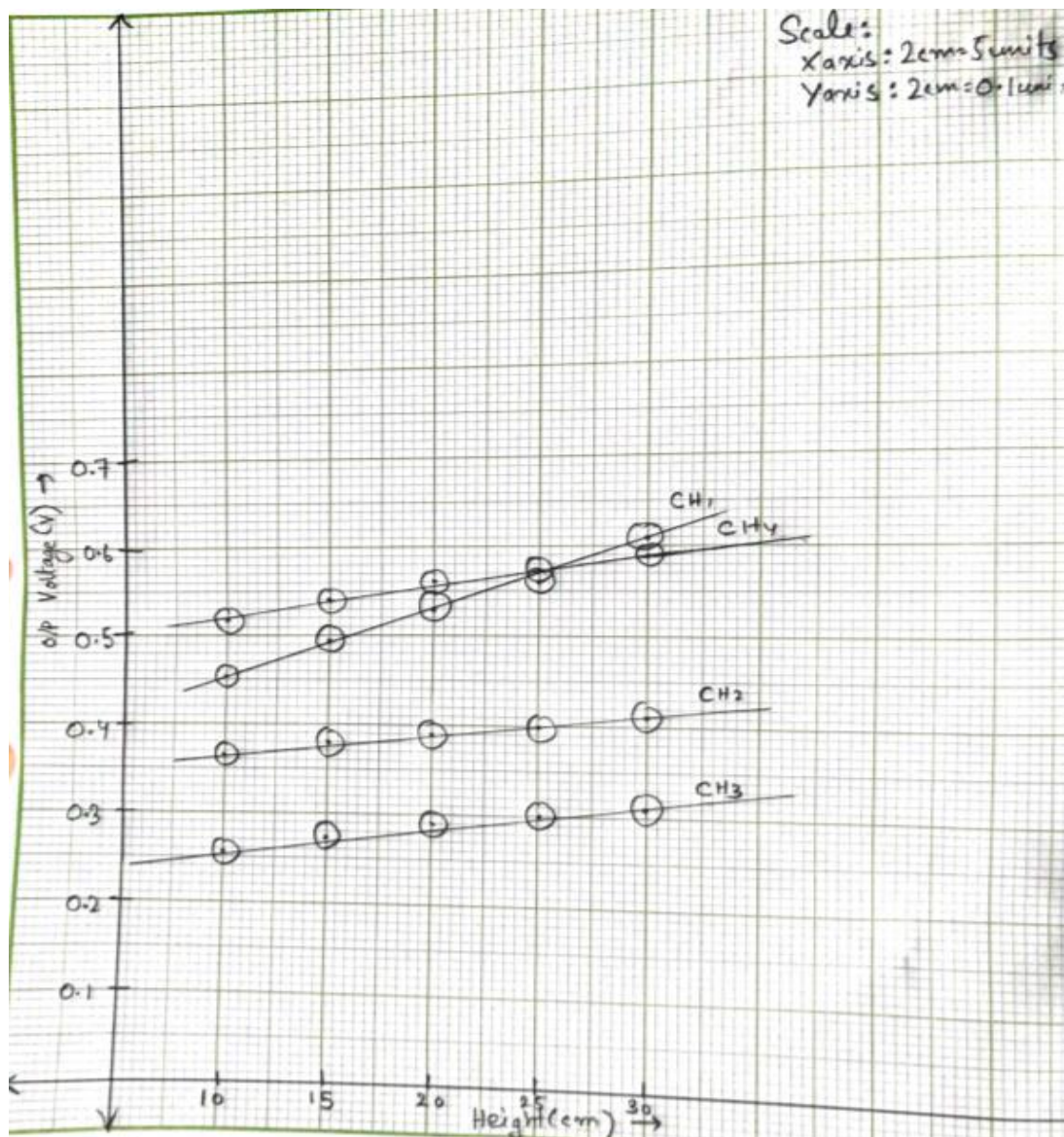
## **CIRCUIT DIAGRAM:**



### OBSERVATION:

Height (cm)	Output Voltages (V)				Error
	CH <sub>1</sub>	CH <sub>2</sub>	CH <sub>3</sub>	CH <sub>4</sub>	
10	0.454	0.365	0.259	0.520	0.085
15	0.495	0.380	0.271	0.540	0.085
20	0.530	0.390	0.290	0.560	0.085
25	0.560	0.400	0.300	0.570	0.085
30	0.610	0.410	0.310	0.590	0.085

### GRAPH:



# CONCLUSIONS

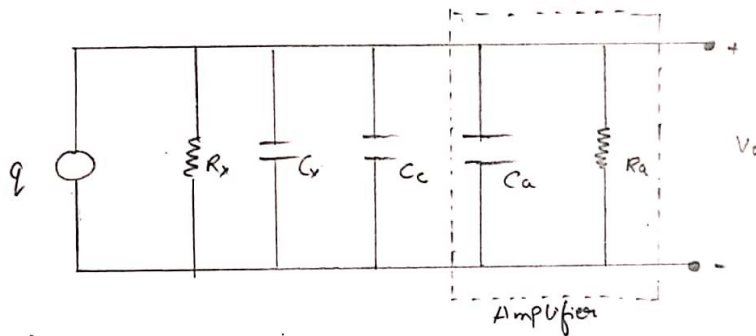
We have successfully built a Transducer Circuit that enables the conversion of mechanical energy (applied in form of mechanical vibration) into electrical energy using the principle of 'Piezoelectric Effect' by employing piezoelectric crystals, and thereby measuring mechanical energy.

# DISCUSSION

## 1. What is the objective of this experiment?

The objective of the experiment is to measure the change in force when a weight is suddenly dropped and then converting change to an electrical charge.

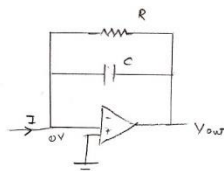
## 2. Draw the electrical equivalent circuit of piezoelectric transducer?



Where  
 $q$  = Charge generated  
 $R_x, C_x$  = Resistance, Capacitance of Piezo  
 $R_a, C_a$  = Resistance, Capacitance of Amplifier  
 $C_c$  = Capacitance of Cable

## 3. What is the function of the charge amplifier? Derive its output if the output of piezo electric transducer is current $I$ .

Here the electrical signal(charge) produced is very small. The function of the charge amplifier is to amplify the electrical signal generated by piezo electric material to a higher value for the accurate measurement. A charge amplifier is an electronic current integrator that produces a voltage output proportional to the integrated value of the input current, or the total charge injected.



$$V^+ = V^- = 0V$$

$$V_{out} = \frac{1}{C} \int I dt$$

$$V_{out} = \frac{I}{CS} \left[ \frac{1}{j\omega C} \right]$$

#### **4. What do you think is the function of sample and hold (or peak detector) circuit?**

Here the output from the piezoelectric material is an analog signal, we need to convert it into a constant DC output. Here multiple samples need to be measured at the same time and each value has to be sampled and held, using a common sample clock. This can be done using sample and hold circuits.

A sample and hold circuit is an analog device that samples the voltage of a continuously varying analog signal and holds its value at a constant level for a specified minimum period of time.