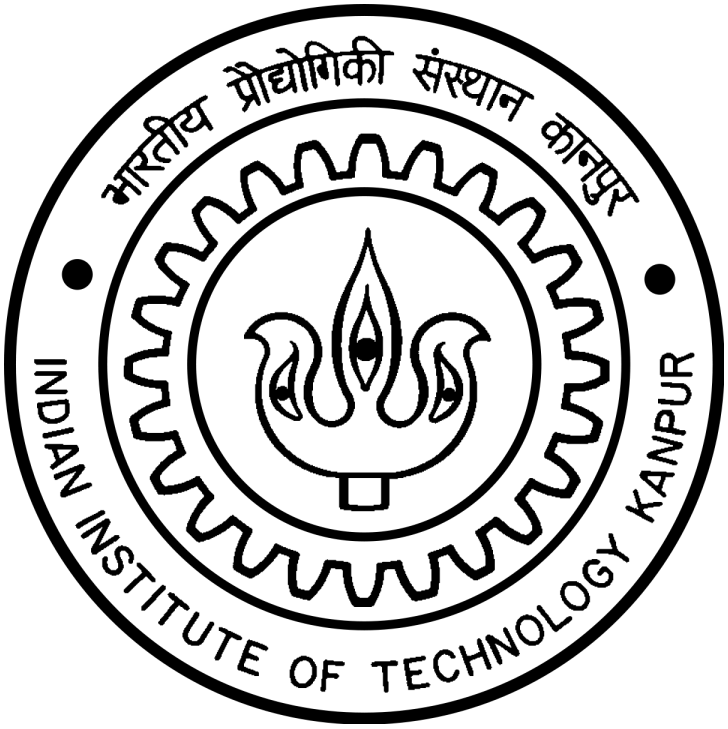

AE - 251A

EXPERIMENTS IN AEROSPACE ENGINEERING

LOAD CELL, STRAIN MEASUREMENT, RT-FGPA

SANKET GAGGAR - 170629
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AIM

1. To measure the strain due to an externally applied loading with the help of a strain gauge.
2. Demonstration of load cell indicators.
3. Demonstration of Stepper motor.
4. Demonstration of RT-FGPA.

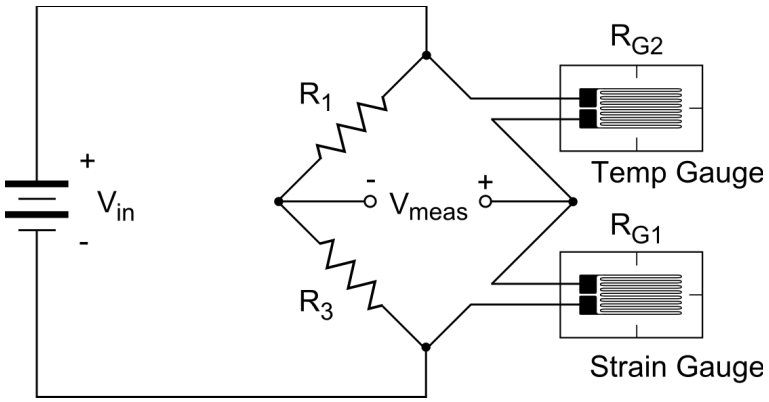
EXPERIMENT 1 - STRAIN GAUGE

- INTRODUCTION

  A Strain gauge (sometimes referred to as a Strain gage) is a sensor whose resistance varies with applied force; It converts force, pressure, tension, weight, etc., into a change in electrical resistance which can then be measured. When external forces are applied to a stationary object, stress and strain are the result. Stress is defined as the object's internal resisting forces, and strain is defined as the displacement and deformation that occur.

- APPARATUS
  1. Strain indicator
  2. Long Aluminium beam
  3. 350 Ω strain gauge
  4. Switching unit (BLH)
  5. Weighing pan
  6. 5 x 200 gm weights

- PROCEDURE
  1. Set up all the connections and apparatus using the schematic diagram.

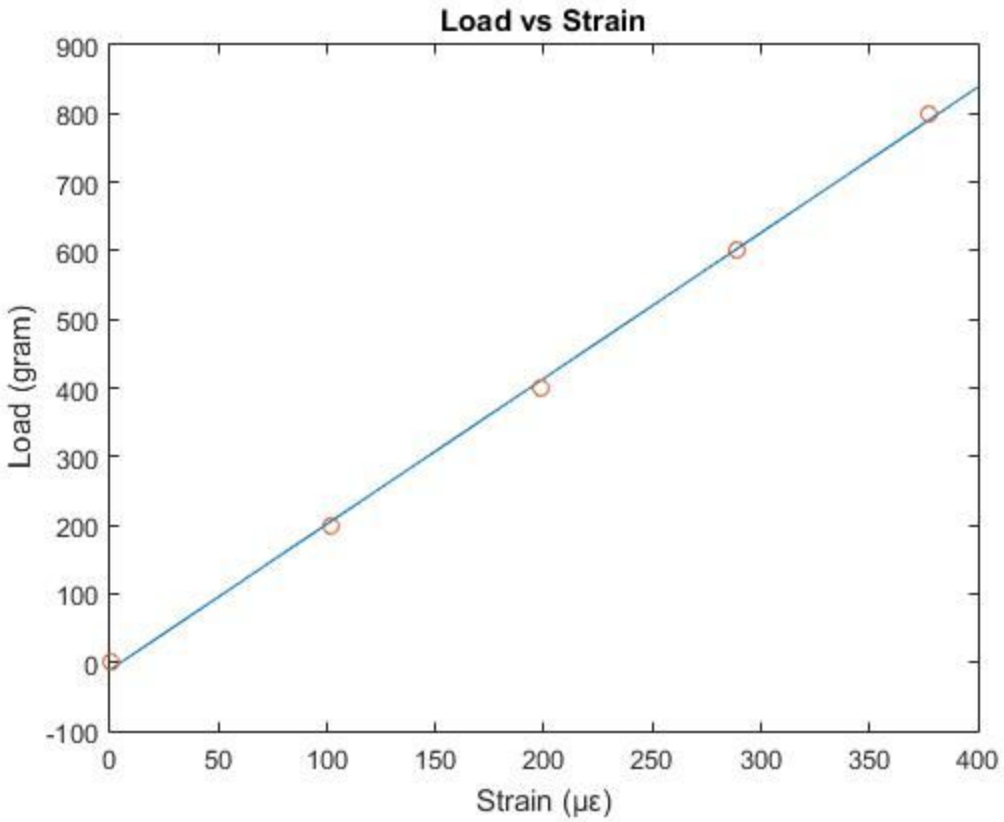


2. Calibrate the zero of the indicator.
3. Load all 200 gm weights one after other and measure the corresponding strain at each step.
4. Unload all the weights one by one and measure the corresponding strain at each step.

- OBSERVATION

SERIAL NO.	LOAD (gm)	LOADING STRAIN (μm/m)	UNLOADING STRAIN (μm/m)	AVERAGE STRAIN (μm/m)	STRAIN (μɛ)
1	0	-17	-10	-13	0
2	200	84	93	88	102
3	400	180	192	186	199
4	600	273	280	276	290
5	800	364	364	364	377

- RESULT



- CONCLUSION
  The relation between Load and strain is linear.

EXPERIMENT 2 - LOAD CELL

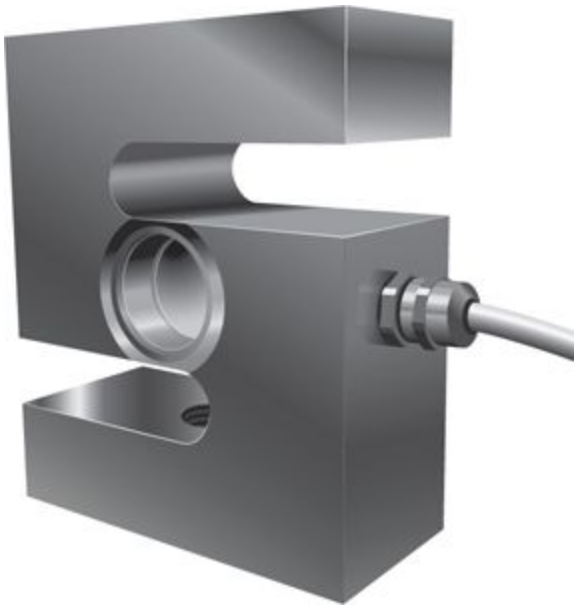
- INTRODUCTION
  A load cell is a transducer which converts force into a measurable electrical output. Although there are many varieties of load cells, strain gage based load cells are the most commonly used type. Strain-gage load cells convert the load acting on them into electrical signals. The gauges themselves are bonded onto a beam or structural member that deforms when weight is applied. In most cases, four strain gages are used to obtain maximum sensitivity and

temperature compensation. Two of the gauges are usually in tension, and two in compression, and are wired with compensation adjustments. When weight is applied, the strain changes the electrical resistance of the gauges in proportion to the load. Other load cells are fading into obscurity, as strain gage load cells continue to increase their accuracy and lower their unit costs.

- TYPES OF LOAD CELLS
    1. Compression / Tension load cells - Compression / tension load cells can be used for applications where the load may go from tension to compression and vice versa. They are ideal for space restricted environments. Threaded ends facilitate easy installation.
    2. S-beam load cells - A S-Beam load cell get its name from its S shape. S-Beam load cells can provide an output if under tension or compression. Applications include tank level, hoppers and truck scales. They provide superior side load rejection.
    3. Bending beam load cells - A Bending beam load cell can be used in multiple load cell applications, tank weighing and industrial process control. It features low profile construction for integration into restricted areas.
    4. Platform and single point load cells - Platform and single point load cells are used to commercial and industrial weighing systems. They provide accurate readings regardless of the position of the load on the platform.
    5. Canister load cells - Canister load cells are used for single and multi-weighing applications. Many feature

an all stainless steel design and are hermetically sealed for washdown and wet areas.

6. Low profile load cells - Low profile load cells are basically compression and tension/compression load cells. Mounting holes and female threads provide easy installation. Used frequently in weighing research and in-line force monitoring.



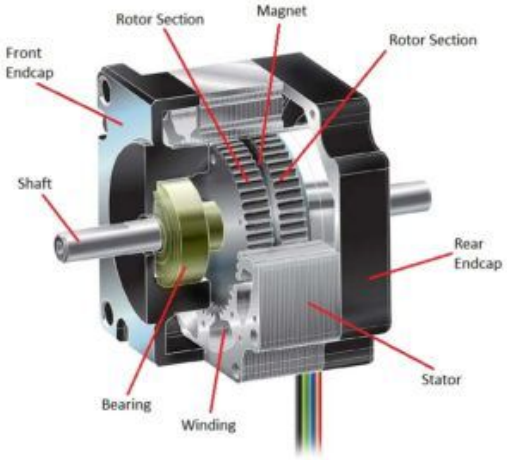
S-beam load cell

- CONCLUSION
  We got to know about load cell indicators.

EXPERIMENT 3 - STEPPER MOTOR

- INTRODUCTION
  A stepper motor is an electromechanical device it converts electrical power into mechanical power. Also it is a brushless, synchronous electric motor that can divide a full rotation into an expansive number of steps. The motor's position can be controlled accurately without any

feedback mechanism, as long as the motor is carefully sized to the application. Stepper motors are similar to switched reluctance motors.The stepper motor uses the theory of operation for magnets to make the motor shaft turn a precise distance when a pulse of electricity is provided. The stator has eight poles, and the rotor has six poles. The rotor will require 24 pulses of electricity to move the 24 steps to make one complete revolution. Another way to say this is that the rotor will move precisely 15° for each pulse of electricity that the motor receives.



EXPERIMENT 4 - RT-FGPA (REAL TIME FIELD PROGRAMMABLE GATE ARRAY)

- INTRODUCTION

FPGA is a device that contains a matrix of reconfigurable gate
array logic circuitry. When it is configured, the internal circuitry
is connected in a way that creates a hardware implementation
of the software application. A Field Programmable Gate Array
(FPGA) offers significant advantage over the off shelf Application Specific Standard Product (ASSP) solutions in the areas of
performance, flexibility and inventory control. FPGA is a programmable logic device, so the advantage is that we can control
the hardware resources by being coded.