CMR INSTITUTE OF TECHNOLOGY

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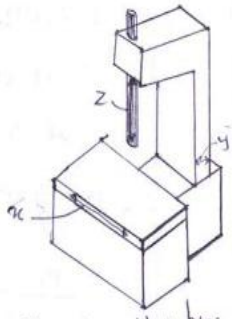
Internal Assesment Test –3

Sub:Mechanical Measuremnts & Metorlogy				Code: 15ME46B
Date: 21/05/2018	Duration: 90 mins	Max Marks: 50	Sem: IV	Branch (sections):ME (A & B)

Answer any FIVE FULL questions. Good luck!

	Scheme and Solution	Marks	OBE CO	OBE RBT
1	What are Coordinate measuring machine & explain the types of CMM.	[10]		
Solu..	Coordinate measuring machine [CMM] CMM is a 3D device for measuring the physical geometrical characteristics of an object. CMM is a specialised form of an industrial robot. CMM include three main components - main structure - probing system and - Data collection & reduction system.	2 Marks	CO4	L2
	Types of CMM i) Cantilever type :- A vertical probe moves in the Z axis carried by a cantilevered arm that moves in the Y-axis. This arm also moves laterally through the X-axis.  Figure : cantilever type	2 Marks		
	Advantages: - Large measuring range - maximum accessibility.	2 Marks		

Disadvantages:

- Bending of the cantilever above the measuring area.

Applications:

For checking sheet metal, cast iron and steel parts in the automotive industry, Aircraft & Ship building.

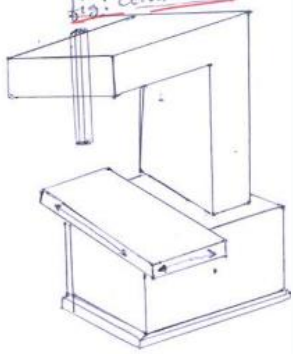
ii) Column type:

often referred to as universal measuring m/c instead of CMM.

The column type CMM construction provides exceptional rigidity and accuracy.

These machines are usually reserved for gauge rooms rather than inspections.

fig: column type



2 Marks

Advantages:

- High accelerations & speed
- low weight & large supporting base

Disadvantages:

- Suitable only for small measuring ranges
- Only since the projecting part of the column must have short length due to its rigidity

2 marks

Applications:-

- In precision measurement on gauges & master parts.

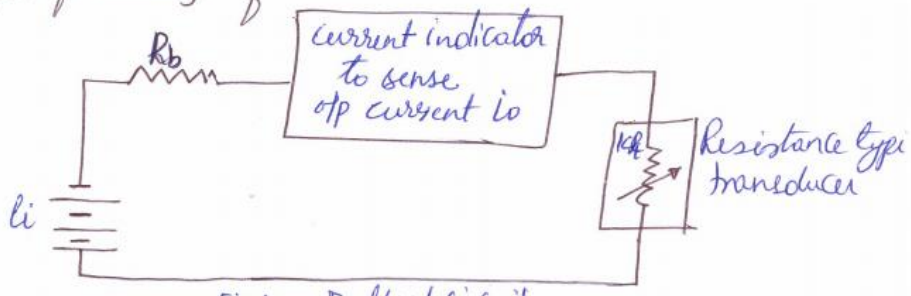
2 With a neat sketch/ circuit diagram explain ballast circuit. [10]

Solu.

A ballast circuit is only a simple variation of the current sensitive circuit. In this case a voltage sensitive device is connected across the transducer as shown in figure. It is also called voltage sensitive circuit.

CO5 L3

A ballast resistor R_b, is the resistance of the measuring circuit excluding the transducer.
A ballast resistance is very much essential in voltage sensitive circuit since in the absence of the ballast resistance R_b, the voltage indicator will always record the full source of voltage e_i
Hence some value of resistance R_b is necessary for proper functioning of the circuit. 3 Marks



3 Marks

Figure - Ballast circuit.

By ohm's law, the o/p current is

$$i_o = \frac{e_i}{R_b + KR_t}$$

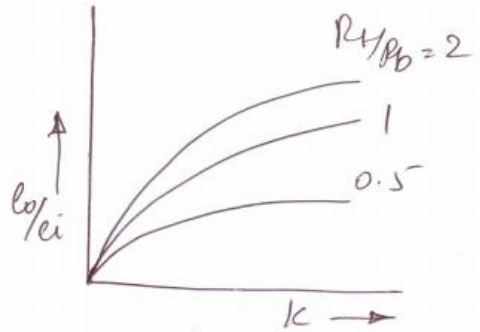
If e_o is the voltage across KR_t, which is indicated by the voltage indicator, then the o/p voltage

$$e_o = i_o (KR_t)$$

$$= \frac{e_i KR_t}{R_b + KR_t}$$ 2 Marks

This can be written as, $\frac{e_o}{e_i} = \frac{KR_t}{R_b + KR_t} = \boxed{\frac{KR_t/R_b}{1 + (KR_t/R_b)} = \frac{e_o}{e_i}}$

For various values of R_t/R_b the o/p e_o/e_i is as



2 Marks

I/p – O/p relationship for Ballast circuit.

3	Explain oscillograph with neat sketch.	[10]		

Solu..

Oscillographs:

Works on the principle of D'Arsonval meter movement.

They are two types:

i) Direct writing stylus type:

This employs some form of stylus which directly contacts a moving paper various forms of stylus types may be used. The recording is accomplished through the use of link, or by heated stylus on a treated paper or by means of a stylus and pressure-sensitive paper as shown in figure.

2 Marks

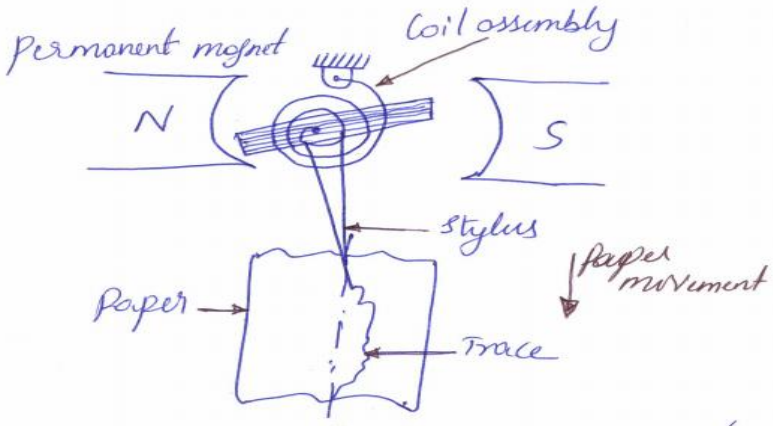


Figure - Stylus type oscillograph.

ii) Light beam or mirror type.

4 Marks

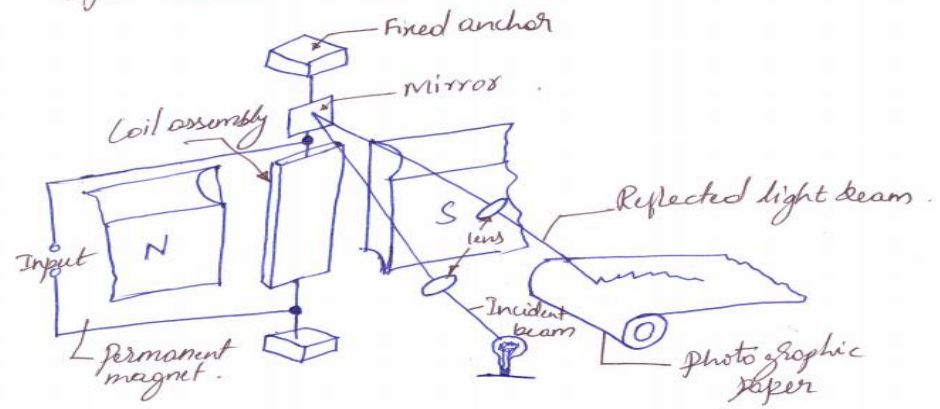


Fig: Light Beam oscillograph.

4 Marks

CO4	L2	

4	With a neat sketch explain piezoelectric and photoelectric transducer.	[10]		

Solu..

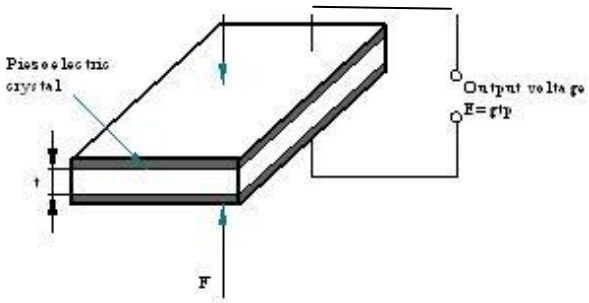
i) Piezoelectric transducer:

Certain materials can produce an electrical potential when subjected to mechanical strain

The fig shows a piezoelectric crystal placed between two plate electrodes and when a force 'F' is applied to the plates, a stress will be produced in the crystal and a corresponding deformation. The induced charge Q=d*F where 'd' is the piezoelectric constant

3 Marks

The output voltage E=g*t*p where, 't' is crystal thickness, 'p' is the impressed pressure & 'g' is called voltage sensitivity given by g=(d/.e), e being the strain.



2 Marks

Figure: Piezoelectric transducer

ii) Photoelectric transducer:

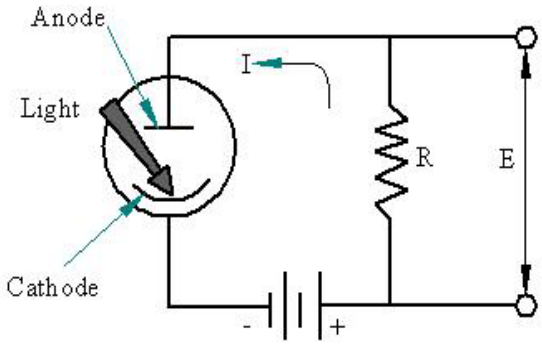
A photoelectric transducer converts a light beam into a usable electric signal. Light strikes the photo emissive cathode and releases electrons, which are attracted towards the anode, thereby producing an electric current in the circuit.

The cathode & the anode are enclosed in a glass or quartz envelope, which is filled with an inert gas.

3 Marks

The photo electric sensitivity is given by; I=s*f

Where, I=Photoelectric current, s=sensitivity, f=illumination of the cathode.



2 Marks

Figure: Photoelectric transducer.

CO5 L1

5	Explain alignment of gear tooth and Parkinson gear tester with neat sketch.	[10]		

Solu..

i) Alignment of gear tooth:

Alignment of each tooth on a gear is very essential otherwise the load will not be distributed evenly over its face.

Tooth alignment can be checked by placing a standard roller in the tooth space and checking for parallelism with a surface plate.

There are two methods to check alignment

i) Analytical method
ii) The functional method.

2 Marks

i) Analytical method:

All the individual elements of the gear teeth are to be checked one by one.

This method is slow and tedious process

The analytical inspection of gears consits of determining the following elements one by one.

i) profile
ii) spacing
iii) pitch
iv) Run out or eccentricity or concentricity
v) Thickness of tooth and
vi) Backlash.

2 Marks

CO4 L2

b) Functional method :

carry out the running test of gear with another gear which is more accurate and it is known as control or master gear.

This method of inspection determines composite errors, vibration and noise.

(ii) Parkinson gear tester :

This test is commonly used in mass production of gear wheels. It takes much less time and gives quite accurate results.

2 Marks

The composite errors can be checked by measuring the variations of the centre distance when the gear to be tested is rotated under spring pressure against a master gear. The test is generally performed on a most commonly used machine called parkinson gear tester.

2 Marks

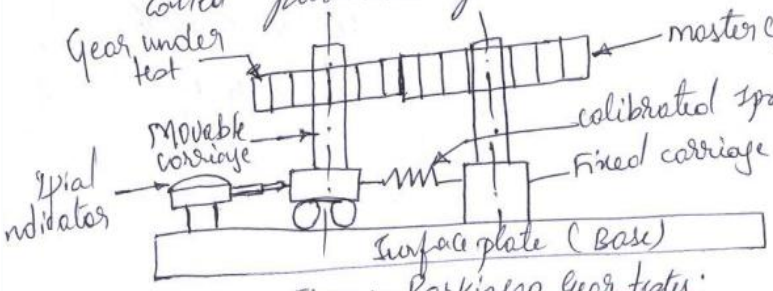


Figure :- Parkinson Gear tester.

If the gears to be tested and master gear rotate manually if their any deviations b/w the gears i.e. variations in the centre distance the calibrated spring helps to move the movable carriage show that deviation will be noted in the dial indicate

If the gear under test and master gear rotates automatically then there will be a electronic sensor which reads the variation b/w the centre distance and gives the out put on a wax paper like a trace.

2 Marks

i) Fully Satisfactory (ii) moderate (iii) Rejected (not satisfactory)

6	Define measurement and explain generalized measurement system with block diagram.	[10]		

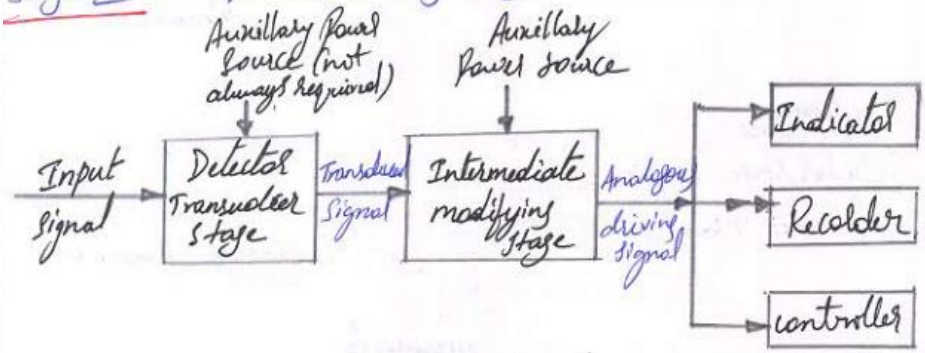
Solu.

Generalized measurement system consisting of three stages

Stage-I :- A detector transducing or sensor stage.

Stage-II - An intermediate modifying stage, or signal conditioning stage

Stage III - A terminating stage. or Read-out stage.



3 Marks

Block diagram of Generalized measuring system.

Stage-I - Detector - Transducer stage.

In this stage, the important function is to detect or sense the input signal. At the same time, it should be insensitive to every other possible input signals

for example, if it is a pressure signal, it should be insensitive to acceleration.

Stage-II - Intermediate modifying stage.

In this stage, the purpose is to modify the transduced information so that it is acceptable to the third, or terminating stage.

Stage-III - Terminating stage.

The third stage provides the information required in a form which can be understand by human senses.

3 Marks

CO5 L2

An example of the generalized measurement system is a simple bourdon tube pressure gauge as shown in figure.

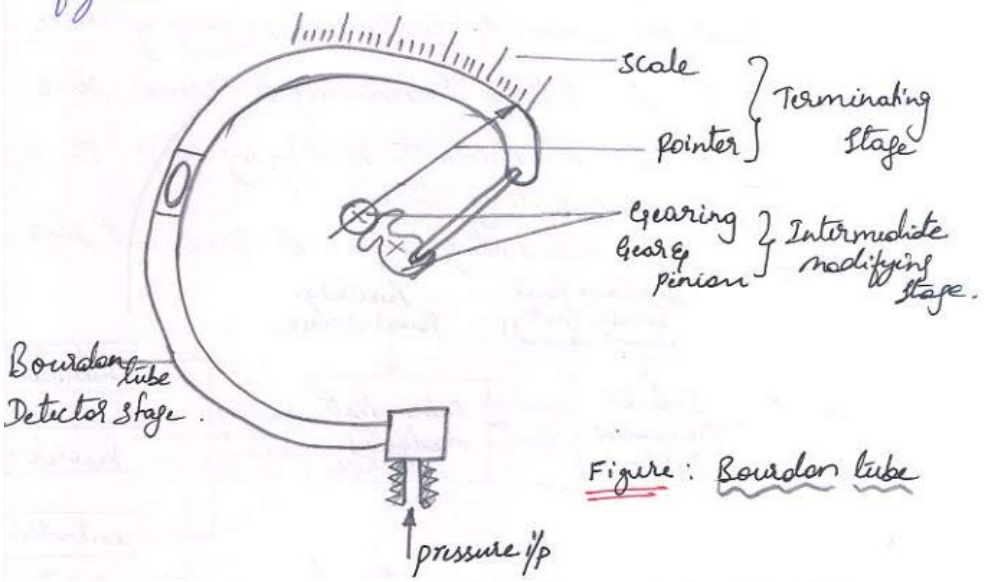
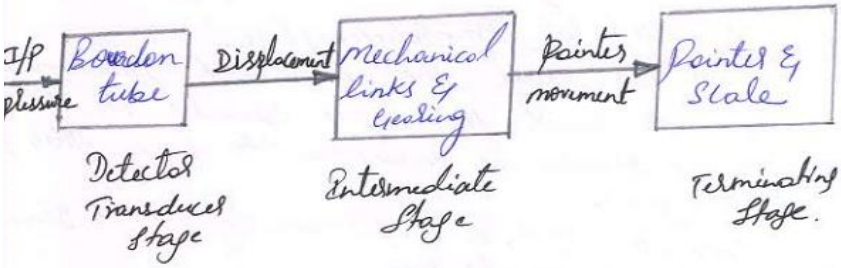


Figure : Bourdon tube

2 Marks



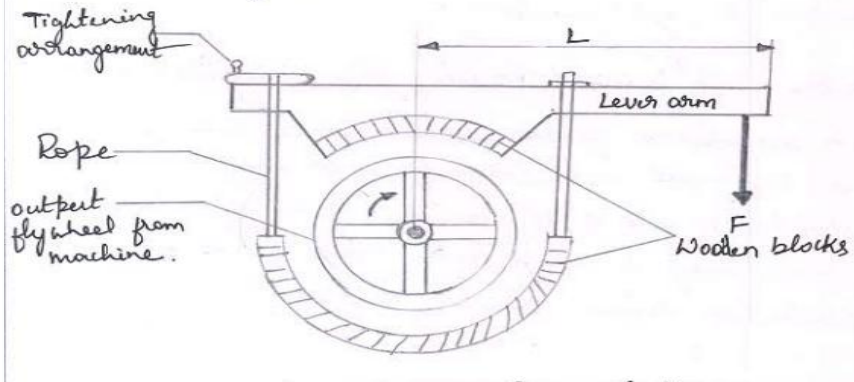
Block diagram of generalized measurement system for Bourdon tube pressure gauge.

2 Marks

7	Explain with a neat sketch, the measurement of torque using proney brake dynamometer	[10]		

Solu.

These dynamometers are of absorption type. The most familiar and simple device is the prony brake as shown in figure.



Schematic of prony brake.

4 Marks

CO6 L3

Two wooden blocks are mounted diametrically opposite on a flywheel attached to the rotating shaft whose power has to be measured. One block carries a lever arm, and an arrangement is provided to tighten the rope which is connected to the arm. The rope is tightened so as to increase the frictional resistance between the blocks and the flywheel. 4 Marks

The torque exerted by the prony brake is

$$T = F.L$$

where F is force measured by conventional force measuring instrument, like balances or load cell etc.

The power dissipated in the brake is then calculated by

$$P = \frac{2\pi NT}{60} = \frac{2\pi FLN}{60} \text{ watts.}$$ 2 Marks

where F - force in newton,
L - length of lever arm in meters.
N - the angular speed in rpm,
and P - power in watts.

The prony brake is inexpensive, but is difficult to adjust & maintain a specific load.

8	Sketch and explain the working principle of optical pyrometer.	[10]	CO6	L2

Solu.

Optical pyrometers uses a method of matching as the basis for their operation.

The two methods used are:

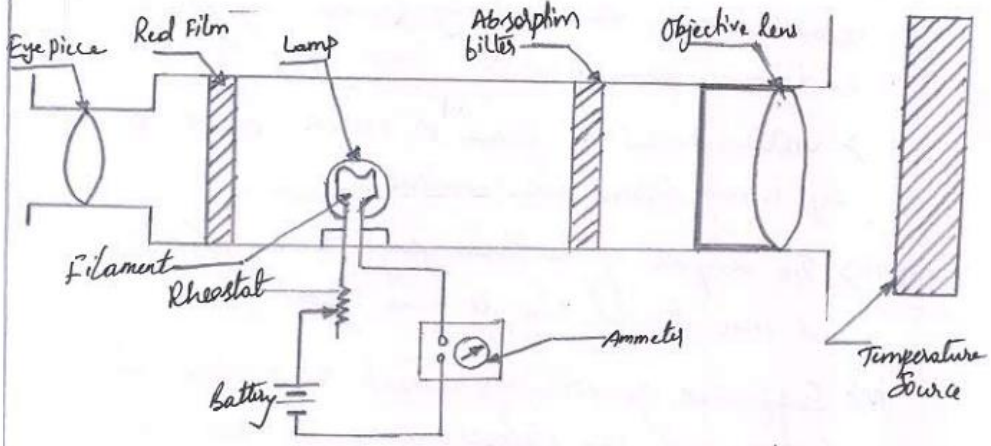
i) The current through the filament may be controlled electrically with the help of resistance adjustment or

ii) The radiation received by the pyrometer from unknown source may be adjusted optically by means of some absorbing devices.

In both the cases the adjustment required, forms the means of temperature measurement.

The pyrometer is positioned towards an unknown temperature such that the objective lens focuses the source in the plane of the lamp filament.

4Marks



4Marks

Fig(a): Schematic of an optical pyrometer.

The eye piece is then adjusted such that the filament and the source appear superimposed. The filament may appear either hotter or colder than the unknown source as shown in figure (b)

When the current passing through the filament is too low, the filament will emit radiations of lesser intensity than that of the source, it will thus appear dark against a bright background shown in fig (i).

Fig(b): Filament appearance

fig (i) fig (ii) fig (iii)

2 Marks

When the current is too high it will appear brighter than the background as shown in fig (ii).

But when correct current is passed through the filament, the filament "disappears" into background fig (iii)