CMR INSTITUTE OF TECHNOLOGY

USN | 1 | C | R | | | | | | | |

Internal Assesment Test –1

Sub:Mechanical Measuremnts & Metorlogy				Code: 15ME46B
Date: 12/03/2018	Duration: 90 mins	Max Marks: 50	Sem: IV	Branch (sections):ME (A & B)

Answer any FIVE FULL questions. Good luck!

		Marks	OBE CO	OBE RBT
1	Define measurement and explain any one type of material length standard.	[10]	CO1	L2
2	Explain principle of sine bar and its uses.	[10]	CO1	L2
3(a)	What are end bars?	[04]	CO1	L1
(b)	A calibrated meter end bar has an actual length of 1000.0006 mm it is to be used in the calibration of two end bars A & B having a length of 500mm. When compared with meter bar αA+αB was found to be shorter by 0.0003mm. In comparing A with B it was found that A is 0.0005mm longer than B. Find the actual length of A & B.	[06]	CO1	L3
4	Explain with a neat sketch principle of autocollimator used for angular measurement.	[10]	CO1	L2
5	The slip gauge set M 38 consists of the following: List the slips to be wrung together to produce the following dimensions: i)29.875mm , (ii) 15.09mm and (iii) 101.345mm	[10]	CO1	L3

Range (mm)	Steps (mm)	No. of pieces
1.005	-	1
1.01-1.09	0.01	9
1.1 – 1.9	0.1	9
1 - 9	1	9
10 - 100	10	10

6	Define fit & explain system of fit with example.	[10]	CO2	L2
7	Write a short note on: (i) Interchangeability, (ii) Accuracy and (iii) Indian standards (IS 919-1963) systems of limits and fits.	[10]	CO2	L1

39+

Mechanical Measurements & Metrology

Date: 15/03/18

Marks: 50

IAT-1 March 2018 [12/03/18]

Question paper Scheme and Solution.

Q.1. Define measurement and explain any one type of material length standard. — 10 Marks

Soln:- Measurement is the process of comparing the known magnitude with predefined standards. — 1 Mark

— 1 Mark

Length standards are:-

i) International prototype meter (or)

ii) Imperial Standard yard.

→ International Prototype Meter :-

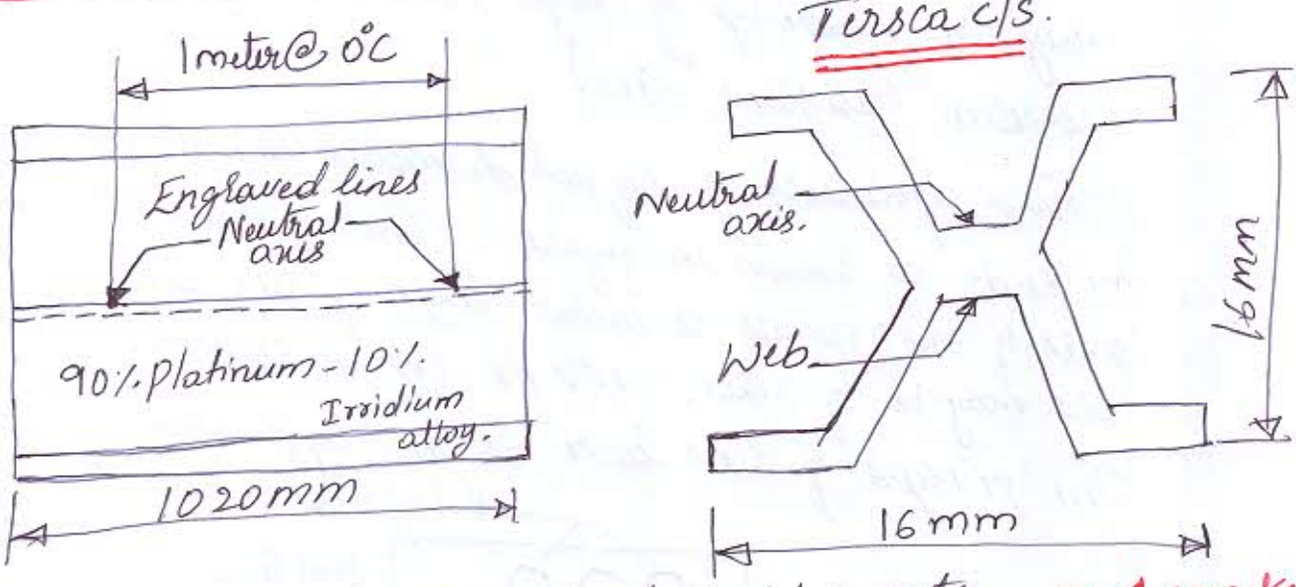


Figure: International prototype meter — 4 Marks.

International prototype meter is defined as the st. line distance at 0°C between the engraving lines of Pure platinum - irridium alloy [90% platinum & 10% Irridium] of 1020mm total length and having a tresca c/s as shown in figure.
It is devised by Henry tresca, hence the name tresca c/s of 16mm × 16mm. — 4 marks

Definition "Meter is defined as the distance measured b/w the engraving lines at 0°C".

Q.2. Explain principle of sine bar and its uses. — 10 Marks

Sol:- Sine bar is designed basically for the precise setting out of angles and is generally used in conjuction with slipgauges and surface plate.
It is used to measure angle less than 45° and they are made up of high carbon, high chromium corrosion resistant steel.
Two cylinders of equal diameters are attached at the ends as shown in figure. The distance b/w the axis of the 2 rollers is called length of sine bar and are may be of sizes, 100 or 200 or 300mm.
The principle of sine bar is the application of trigonometry — 2 marks.

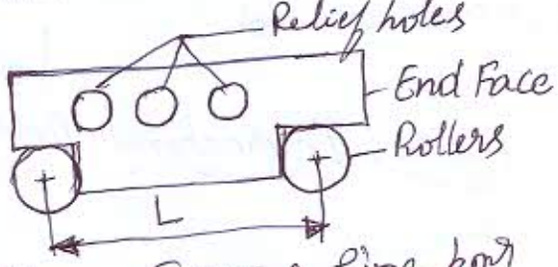


Fig:- Form of Sine bar

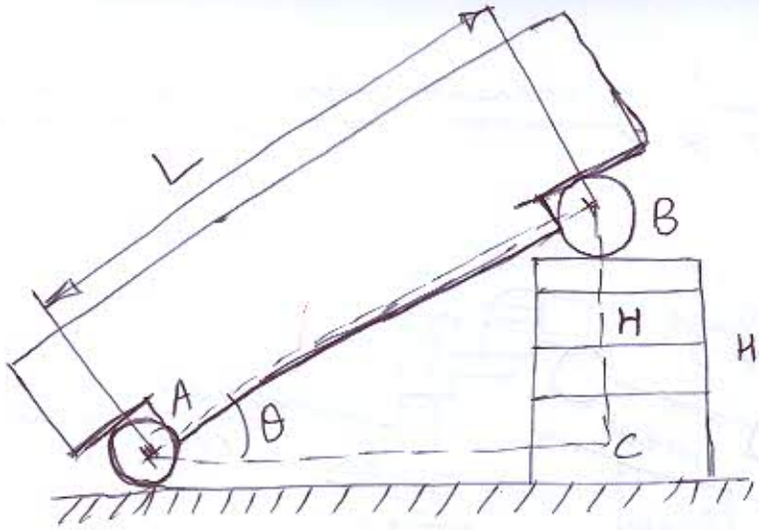


Figure : Principle of Sine bar

$$\sin\theta = \frac{opp}{hyp} = \frac{BC}{AB} = \frac{H}{L}$$

$$\therefore \boxed{\theta = \sin^{-1}(H/L)}$$

— 2 Marks.

Uses of sine bar

i) Measuring known angles.

θ is known, indirect method

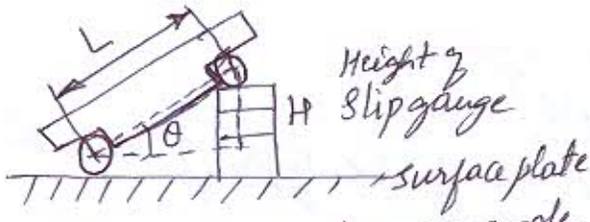


Fig: i) To measure known angle

$\theta = \sin^{-1}(H/L)$

$H = L\sin\theta$.

— 2 marks

ii) Measuring unknown angles.

Fig 2) Measure unknown angles.

$\theta = \sin^{-1}(H/L)$

where, H - height of slip gauge blocks

L → length of sine bar.

By using dial gauge on the specimen, we check the surface is horizontal or not by building slip gauge blocks. Once the surface is flat, we take H value & substitute in the formulae.

— 2 marks.

iii) checking or measuring of unknown angles of heavy component.

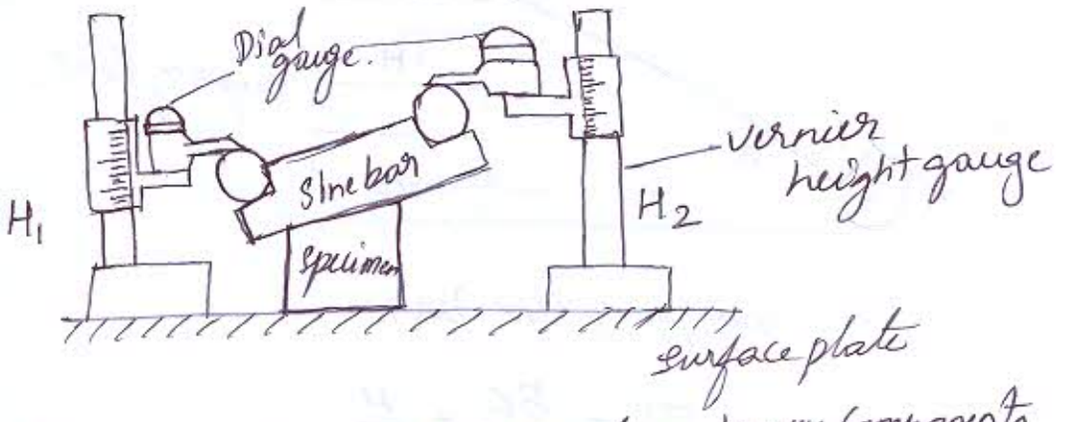


Fig: Measuring unknown angle of heavy components.

With the help of vernier height gauge height H_1 & H_2 will be find, the substitute in the formulae to find angle θ.

$$\sin\theta = \left(\frac{H_2 - H_1}{L}\right) \quad \text{where } H = H_2 - H_1$$

$$\theta = \sin^{-1}\left(\frac{H}{L}\right)$$

L - Length of the sine bar.

— 2 marks.

Q.3. a. What are end bars?

Sol:- End bars are one of the type of end standards. End bars are made up of steel having a cylindrical cls of 22.2 mm in diameter, with face lapped and hardened at the ends.

End bars available in steps of various lengths and are commonly or usually provided in sets of 9 to 12 pieces in steps of 25 mm upto about 1 meter.

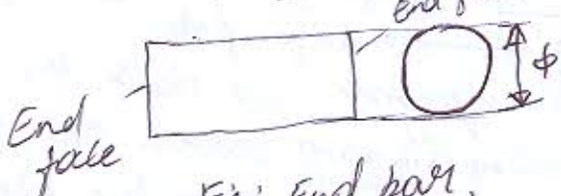


Fig: End bar.

— 4 Marks.

3(b) A calibrated meter end bar has an actual length of 1000.0006 mm it is to be used in the calibration of two end bars A & B having a length of 500mm. When compared with meter bar $\alpha A + \alpha B$ was found to be shorter by 0.0003mm. In comparing A with B it was found that A is 0.0005mm longer than B. Find the actual length of A & B. — (6 Marks)

Soln :-

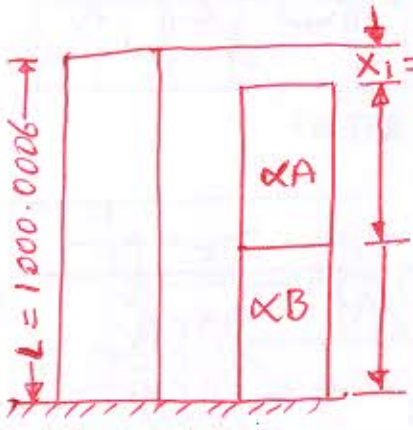


Fig 1 : Compared αA & αB with Std. calibrated bar.

Sketch – 2 marks.

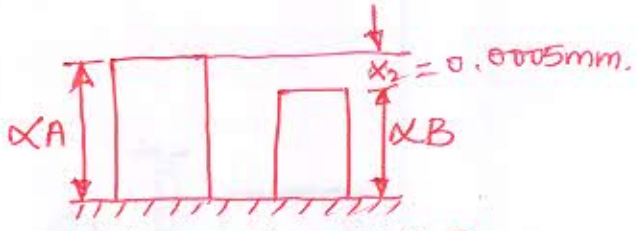


Fig 2: Comparing A & B

From fig 1 :

$L = \alpha A + \alpha B + 0.0003mm$

$1000.0006mm - 0.0003mm = \alpha A + \alpha B$ — eq(i) } 2 - Marks.

From Fig 2 : $\alpha A = \alpha B + 0.0005mm$ — eq(ii)

Sub. eqn (ii) in (i)

$\therefore 1000.0006 - 0.0003 = 2\alpha B + 0.0005mm.$

$2\alpha B = 1000.0003 - 0.0005$

$\alpha B = \frac{999.9998}{2}$

$\therefore \boxed{\alpha B = 499.9999mm}$ — 1 mark

Sub, αB in eqn (ii)

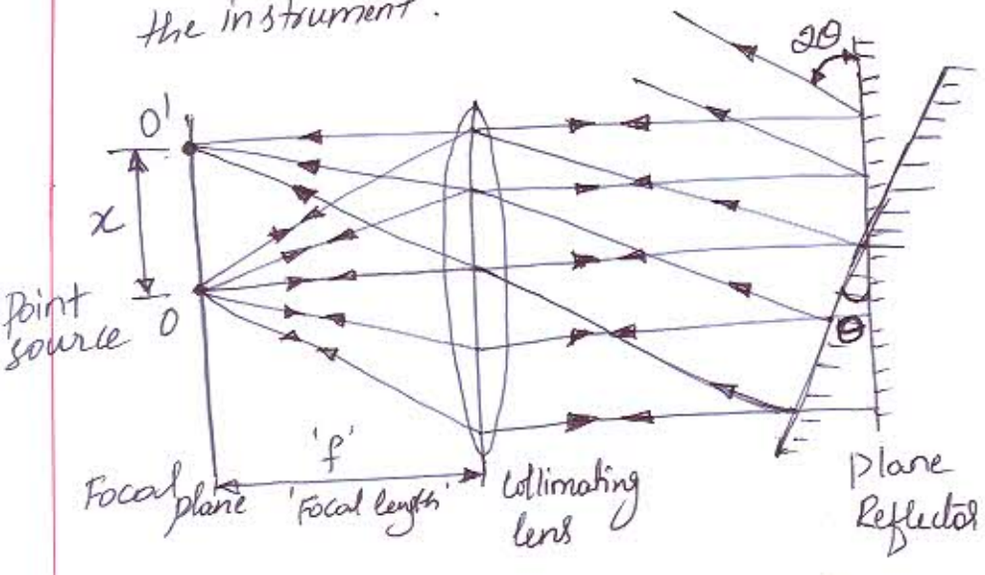
$\alpha A = \alpha B + 0.0005 = 499.9999 + 0.0005mm$

$\boxed{\alpha A = 500.0004\ mm.}$ — 1 mark.

8.4 Explain with a neat sketch principle of autocollimator used for angular measurement: — 10 marks

Soln:- Autocollimator is an optical instrument used for the measurement of small angular deflections. — 1 mark

collimator is a device for producing parallel beam of rays and it is essential to combined an infinity telescope into the instrument. — 1 mark



— 4 marks.

Figure: principle of autocollimator.

'O' is the point source of light placed at the principle focus of collimating lens. The light beam from point 'O' travels as parallel beam of light and strikes the plane reflector which is normal to the optical axis, then it will be reflected back along its own path and refocused at point 'O'.

If the plane reflector is tilted to an angle 'θ' then the parallel beam of light will be reflected by an angle twice the θ. i.e. 2θ, and it will be refocused at point 'O'' on the same plane at a distance of x i.e. OO'. — 2 marks

$\therefore OO' = x = 2\theta \cdot f$ where f - focal length — 1 mark

If the plane reflector moved too much back, then the reflected beam will miss the lens and no image will be formed. — 1 mark

Q.⑤. The slip gauge set M 38 consists of the following — 10 marks

Range (mm)	Steps (mm)	No. of pieces.
1.005	—	01
1.01 - 1.09	0.01	09
1.1 - 1.9	0.1	09
1 - 9	01	09
10 - 100	10	10

List the slips to be wrung together to produce the following dimensions:
i) 29.875 mm, ii) 15.09 mm and iii) 101.345 mm.

Soln:- i) 29.875 mm by using M 38 set.

1.005
28.87
1.07
27.8
1.8
26.00
6.00
20.00
20.00
00.00

(2 marks)

Combination = 20.00 + 6.00 + 1.80 + 1.07 + 1.005
= 29.875 mm. (— 2 marks)

— 4 marks.

ii) 15.09 mm.

1.09
14.00
4.00
10.00
10.00
00.00 (1 m)

Combination = 10.00 + 4.00 + 1.09
= 15.09 mm (1 m)
— 2 marks

iii) 101.345 mm

1.005
100.34
1.04
99.30
1.30
98.00
8.00
90.00
90.00
00.00

(2 Marks)

Combination
= 90.00 + 8.00 + 1.30 + 1.04
+ 1.005
= 101.345 mm (2 marks)

— 4 marks.

Q.6. Define fit and explain system of fit with example. — 10 marks

Soln:- Fit is defined as 'the relationship existing between two parts, shaft and hole, which are to be assembled, with respect to the difference in sizes" is called fit. — 2 marks.

System of fits:-

i) Hole basis system and
ii) Shaft basis system.

i) Hole-basis system:

In hole basis system hole limits dimensions are considered constant and various types of fits are obtained by varying the limit dimensions of the shaft as shown in figure i).

— 2 - marks

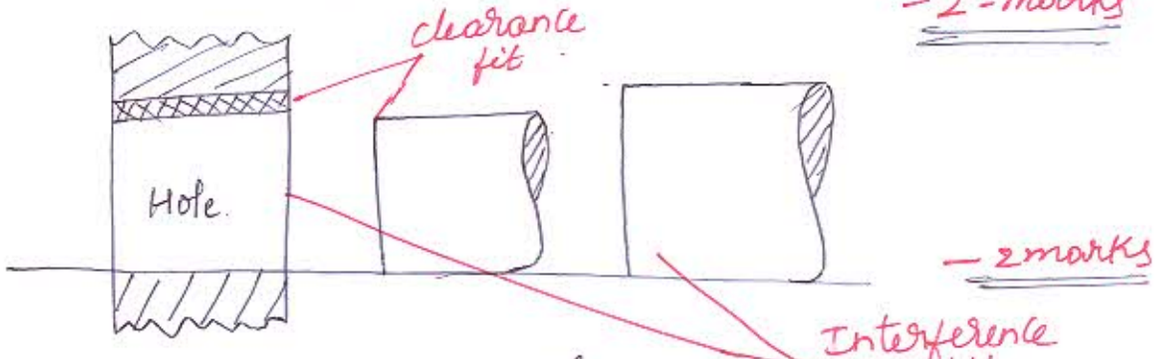


Figure i) Hole-basis System Ex:

ii) Shaft-basis system:

In shaft basis system, the shaft limits kept constant and various types of fits are obtained by varying the limit dimensions of holes.

— 2 marks

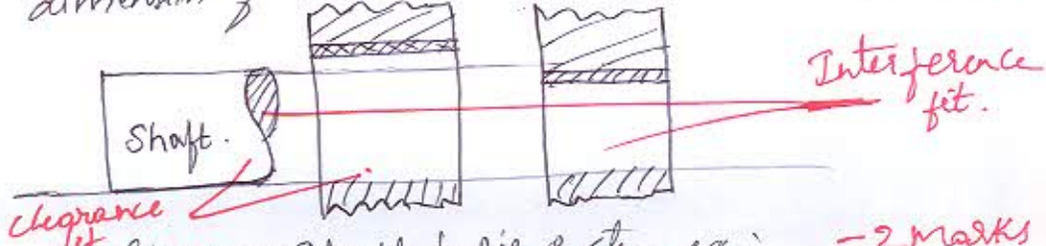


Figure 2: Shaft basis system ex: — 2 marks.

Q.7 Write a short note on:

(i) Interchangeability,

(ii) Accuracy and

(iii) Indian stds (IS 919-1963) system of limits & fits.

Sol:- i) Interchangeability

Interchangeability occurs when one part in an assembly can be substituted for a similar part which has been made to the same drawing.

If there is a interchangeability then any one of the 100 shafts should fit into any of the holes.

There are two types of interchangeability — 2 marks

a) Local interchangeability - When all the parts to be assembled are made in the same manufacturing unit, by following local standards. — 1 mark

b) Universal Interchangeability: The mating parts are drawn from any two different manufacturing source by following international standards. — 1 mark.

ii) Accuracy :-

Accuracy is the closeness with which the readings of the instrument approaches the true values of the quantities measured.

Accuracy may be expressed in percentage based on actual scale reading i.e. % Accuracy = $\frac{V_a - V_r}{V_a}$ V_a - actual & V_r - result value (measured)

— 2 marks

iii) Indian standards (IS919-1963) system of limits and fits

The IS of limits and fits comprises suitable combination of 18 grades of fundamental tolerances and 25 types/grades of fundamental deviations. Toleranas are IT0, IT01, IT1 upto IT16 and 25 grades of F.D is represented by letter symbols. capital letters A to ZC for holes and small or lower case letters a to zc for shafts. 2+2 marks.