Scheme of Evaluation
Internal Assessment Test 1 – Mar.2019

Sub:	Mechanical Measurements & Metrology							**Code:**	17ME46B
Date**:**	05/03/2019	Duration:	90mins	Max Marks:	50	**Sem:**	IV	**Branch:**	ME

Note: Answer Any Five Full Questions.

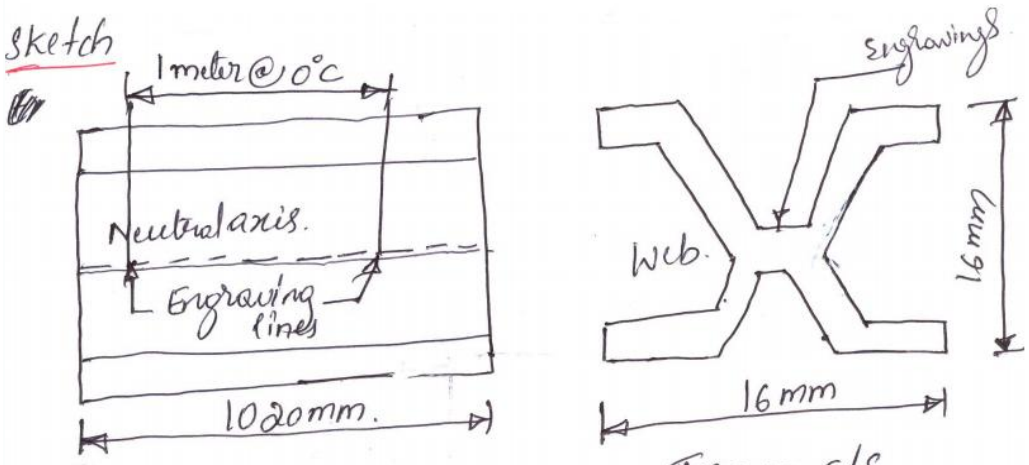
Question #		**Description**	**Marks Distribution**		**Max Marks**
1	a)	Define measurement and explain any one type of material length standard • Definition of Measurement with block diagram • Material standard – International Prototype Meter or Standard yard - Sketch - Explanation	2+ 2 M 2 M 4 M	10 M	10 M
2	a)	What are end standards and explain manufacturing of slip gauges. • End standard explanation – end bars and slip gauges (2 M each) • Manufacturing of slip gauges - Explanation - Sketch (Arrangements of slips on magnetic chuck & Wedging effect – 2 Marks Each)	2+2 M 4 M 2 M	10 M	10 M
3	a)	What are end bars? • Explanation • Sketch	2 M	2M	10 M
	b)	A calibrated meter end bar has an actual length 1000.0006 mm it is to be used in the calibration of two bars A and B each having a length of 500 mm. When compared with meter bar LA +LB found to be shorter by 0.0003 mm. In comparing A with B it was found that A is 0.0005 mm longer than B. Find the actual length of A & B. - Sketch (fig -1 & fig -2)**2 marks each** - **Answers L1 = 500.0004mm**	4 M 2 M	8 M	

		L2 = 499.9990mm	2 M		
4	a)	Explain with a neat sketch principle of autocollimator used for angular measurement. • Collimator • Sketch • Explanation	2 M 2 M 6 M	10 M	10 M
5	a)	Using M112 set of slip gauges, build the following dimensions: i) 29.758mm and ii) 57.895mm • M 112 Set table • 29.758mm • 57.895mm	2 M 4 M 4 M	10 M	10 M
6	a)	List care of slip gauges and explain wringing phenomenon. • List care of slip gauges (Minimum 5 Points – 1 marks each) • Wringing phenomenon. - Sketch - Explanation	5 M 3 M 2 M	10 M	10 M
7	a)	Explain principle of sine bar and its uses. • Sine Principle - Sketch - Formulae • Uses - Measuring angle of small component - Measuring angle of Large component	2 M 2 M 3 M 3 M	10 M	10 M

Internal Assesment Test –1

Sub:Mechanical Measuremnts & Metorlogy				Code: 17ME46B
Date: 05/03/2019	Duration: 90 mins	Max Marks: 50	Sem: IV	Branch (sections):ME (A & B)

Answer any FIVE FULL questions. Good luck!

	Solution	Marks	OBE CO	OBE RBT
1	Define measurement and explain any one type of material length standard.	[10]		
Solu.	Measurement : is the process of comparing the unknown magnitude with predefine standards.	2 Marks		
		2 Marks		
	International Prototype meter			
		2 M	CO1	L2
	Figure : International prototype meter			
	Explanation	4 Marks		
	International prototype meter is a type of material length standard, having a trisca c/s with 16mm by 16mm. It is made of platinum-Irridium alloy [90% platinum - 10% Iridium]. Meter is defined as, the distance measured between the two engraving lines on a platinum - irridium alloy at 0°C.			

2 What are end standards and explain manufacturing of slip gauges. [10]

Solu.

End Standards :

The need of end standards arises as the use of line standards and their copies was difficult at various place in the workshops. End Standards can be made to a high degree of accuracy

- **End bars** :- Made up of steel having cylindrical c/s of 22.2 mm diameter with face lapped and hardend at the ends are available in sets of various lengths. — 2 Marks

  End bars are usually provided in sets of 9 to 12 piece in step size of 25 mm upto a length of 1 metre.

ii) **Slip gauges**: are practical end standards and can be used in linear measurement in many ways. These were invented by Swedish Engineer C E Johnson. — 2 Marks

  Slip gauges are of rectangular and blocks of hardened and stabilised high grade cast steel.

Manufacture of Slip Gauges: The method of Manufacturing slip gauges developed by National physical Laboratory (NPL) is as follows: — 4 Marks

- Section of high grade steel gauge blocks by preliminary operations.
- Initial hardening heat treatment to increase hardness and wear resistance.
- Stabilizing treatment is performed by heating and cooling the gauge blocks successively, after rough grinding all over to remove hardening stresses.
- The gauges are heated in sand & cooled slowly at each stages i.e., temperatures 40°, 70°, 130° & 200°c.

Four stages of

- Eight gauges of one size are then mounted on a special type of Magnetic chuck, and spot ground on each face. A preliminary lapping operation is also carried out which make all gauges parallel to about 0.0002mm and within about 0.002mm size as shown in fig (a)

CO1 L2

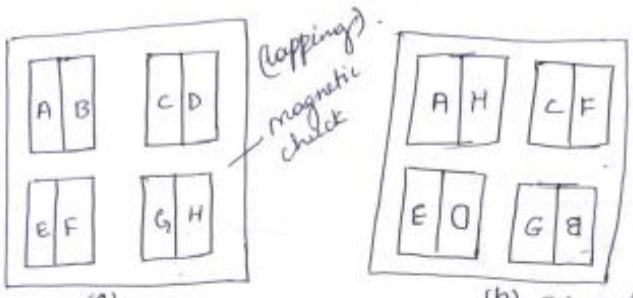


Fig: Arrangement of slip gauges on lapping chuck.

when the gauges have been lapped in this position, all faces will lie in one plane, which will not necessarily be exactly parallel to the plane of chuck.

- In order to eliminate this wedging effect, one gauge being turned end for end in the process, as shown in fig (b).
- Further lapping produces very high degree of parallelism & equality of size b/w the eight gauges.
- Then all the eight gauges are compared to standard equal to their nominal aggregate size.

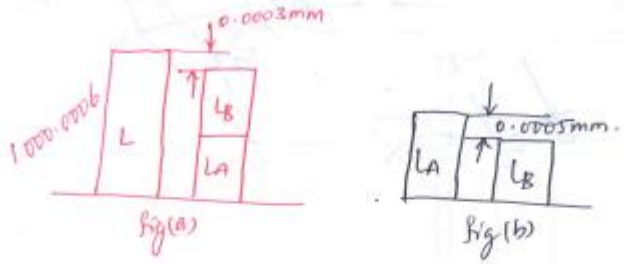
2 Marks

3	(a) What are end bars? (b) A calibrated meter end bar has an actual length 1000.0006 mm it is to be used in the calibration of two bars A and B each having a length of 500 mm. When compared with meter bar LA +LB found to be shorter by 0.0003 mm. In comparing A with B it was found that A is 0.0005 mm longer than B. Find the actual length of A & B.	[10]		CO1	L3

Solu.. End bars :- Made up of steel having cylindrical c/s of 22.2 mm diameter with face lapped and hardened at the ends are available in sets of various lengths.

End bars are usually provided in sets of 9 to 12 pieces in step size of 25 mm upto a length of 1 metre.

2 Marks



4 Marks

From fig(a) $L - X_1 = L_A + L_B$ —(i)

From fig (b) $L_A = L_B + X_2$ —(ii) Substitute (ii) in (i)

$L - X_1 = L_B + L_B + X_2 \Rightarrow 1000.0003 = 2L_B + 0.0005$

$L - X_1 = 2L_B + X_2$ $\quad 2L_B = 999.9998$

$L_B = \frac{L - X_1 - X_2}{2} = \frac{1000.0006 - 0.0003 - 0.0005}{2}$

$L_B = 499.999$ mm.

$\therefore L_A = 499.9999 + 0.0005 = 500.0004$ mm.

4 Marks

4	Explain with a neat sketch principle of autocollimator used for angular measurement.	[10]	CO3	L2

Solu..

Principle of Autocollimator

Is an optial instrument used for the measurement of small angular deflection/differences accurately.

Collimator is a device for producing a parallel beam of rays or radiation.

In autocollimator it is essentialy an ∞ infinity telescope and a Collimator combined into one instrument.

2 Marks

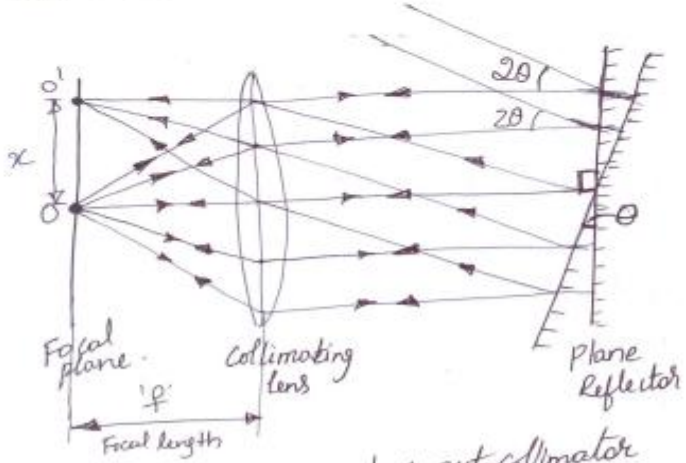


Fig: Principle of autocollimator

4 Marks

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

If the plane reflector tilted to an angle 'θ' then the parallel beam of light will be deflected through twice the angle i.e. 2θ and it will be brought to focus at point 'O'' in the same plane at a distance 'x' from 'O'.

$\therefore OO' = x = 2\theta f$. where f - Focal length of the lens.

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

4 Marks

5 Using M112 set of slip gauges, build the following dimensions:

i) 29.758mm and ii) 57.895mm [10]

Solu.

M112 Nolmal set :

Range (mm)	Steps (mm)	No. of pieces
1.001 to 1.009	0.001	9
1.01 to 1.49	0.01	49
0.5 to 24.5	0.50	49
25, 50, 75, 100	25	4
1.0005	-	1
Total		112

2 Marks CO1 L2

i) 29.758 mm using M112 set.

1.008
28.75
1.25
27.50
2.50
25.00
25.00
00.00

Combination = 25.00 + 2.50 + 1.25 + 1.008
= 29.758 mm.

4 Marks

ii) 57.895 mm

1.005

56.89

1.39

55.50

5.50

50.00

Combination = 50.00 + 5.50 + 1.39 + 1.005

= 57.895 mm.

4 Marks

6	List care of slip gauges and explain wringing phenomenon.	[10]	CO1	L1

Solu.

Care of gauge blocks.

The following should be observed to preserve the accuracy of gauge blocks.

i) It is important that the measuring faces are clean and undamaged (closely check for small scratches)

ii) Measuring faces should not be fingered, so that the risk of tarnishing is minimised.

iii) Gauges should not be wrung together for longer than necessary.

iv) care should be taken when it is wrung, if one is accidentally dropped it could be damaged.

v) Immediately after use, the gauges should be slide apart (not pulled), clean the measuring faces with a suitable protective grease.

vi) When any gauge is dropped, its edges most likely to be damaged or small scratches on the surface.

vii) The gauges and their case should be protected from dust and dirt.

5 Marks

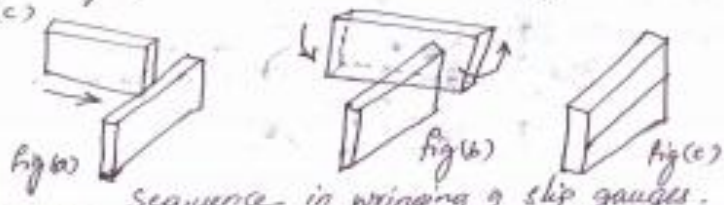
Wringing Phenomena :-

- The phenomena of wringing takes place when two flat lapped surfaces are placed in contact with a sliding movement.
- Generally a minute amount of grease & moisture must be present between the surfaces for them to wring satisfactorily.
- It has been found that the gap between the two wrung flat pieces is approximately 5 nanometers (10^{-9}mm), which has no effect on the total length.
- The technique of wringing together two slip gauges is quite simple, provided the surfaces are clean & free from burrs.

The surface should wash from oil in petrol, benzene, carbon tetra chloride and wiped used cloth.

2 Marks

Then one gauge is placed at right angles to the other & slide one over the other as shown in fig (a), while pressing them together a twisting motion is applied until the gauge blocks are lined up as shown in fig (b) & (c)

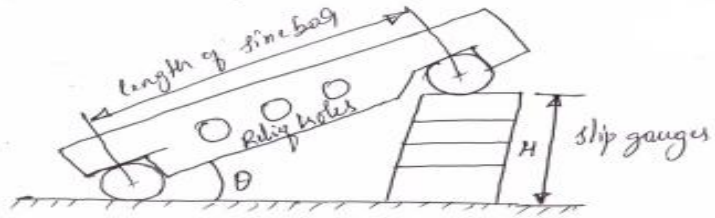


3 Marks

Sequence in wringing of slip gauges.

Similarly, for seperating the two wrung slip gauges, combined sliding and twisting motion should be used as no attempt should be made to seperate them directly.

7	Explain principle of sine bar and its uses.	10 Marks		
Solu.	Sine bar is a high precision and most accurate instrument. It is used in conjunction with a set of slip gauges. Sine bar is made of high carbon, high chromium corrosion resistant steel with known dimensions of 100, or 200 or 300mm in length. It works or uses the law of trigonometry for angle measurement. $\sin\theta = H/L$, (or) $\theta = \sin^{-1}(H/L)$	2Marks	CO3	L2



2 Marks

Figure: Sine bar.

Uses of sine bar:

i) To check/measure angle of small component:

In this case angle is unknown, need to find out by building slip gauges. Angle plate.

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

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

H = Height of slip gauge blocks

L = length of sine bar.

Fig:- Sine bar checking unknown angle.

ii) To check unknown angle of Heavy component:

In this case Sine bar is used to measure the unknown angle of a heavy component using vernier height gauges, placed on the roller on both the scales.

3 Marks

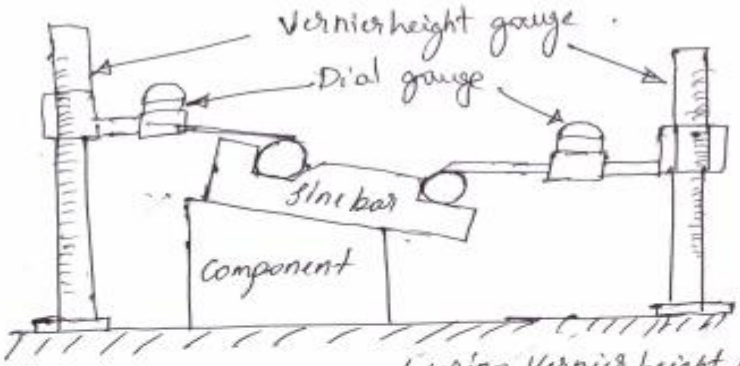


Fig :- Angle measurement using Vernier height gauge & Sine bar.

3 Marks

From 2 scales (vernier height gauge) we find h_2 & h_1, the substitute in formulae.

$\theta = \sin^{-1}\left(\frac{h_2 - h_1}{L}\right)$.