Code No.: 9A03603/R09

B.Tech. III Year II Semester Regular and Supplementary Examinations Set-3 Solutions

April/May - 2013

METROLOGY

(Mechanical Engineering)

Time: 3 Hours Max. Marks: 70

*Answer any **FIVE** Questions*

***All** Questions carry **equal** marks*

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1. (a) By means of simple diagrams representing the hole and shaft, show the essential conditions for,
   (i) Clearance fit
   (ii) Interference fit.
   Give practical example for each. **(Unit-I, Topic No. 1.2)**
   (b) A steel shaft is made within limits on its diameter of 60.02 and 50.96 mm. State the upper and lower limits of bore size of a bush to give a maximum clearance of 0.1 mm and minimum clearance of 0.02 mm. **(Unit-I, Topic No. 1.3)**

2. Discuss the procedure of subdivisions of the end standard by Brooke's level comparator. **(Unit-IV, Topic No. 4.2.1)**

3. (a) Discuss about the following terms related to testing of optical flat,
   (i) Flatness test
   (ii) Parallelism test. **(Unit-III, Topic No. 3.1.3)**
   (b) Write a note on the care to be taken in the use of optical flat. **(Unit-III, Topic No. 3.1.3)**

4. (a) Show the schematic representation of roughness on machined components. **(Unit-IV, Topic No. 4.1.1)**
   (b) Explain the terms form factor and bearing area curve. **(Unit-IV, Topic No. 4.1.2)**

5. (a) Name the important dimensions of V- thread which control the fitting of threads. **(Unit-V, Topic No. 5.1)**
   (b) Explain why it is essential to measure/gauge the different elements of any screw thread. **(Unit-V, Topic No. 5.1)**

6. (a) Explain the tests for the flatness of bed and for the straightness and parallelism of bed ways of a lathe machine. **(Unit-VI, Topic No. 6.2)**
   (b) Explain the tests for the true running of the head stock centre. **(Unit-VI, Topic No. 6.2)**

7. (a) Explain various methods with neat sketches, generally used for measuring the gear tooth thickness. **(Unit-VII, Topic No. 7.1.3)**
   (b) Describe suitable methods for testing the important geometric features of a ground 'Master' gear. **(Unit-VII, Topic No. 7.1.2)**

8. (a) Explain the different types of surface modification process. **(Unit-VIII, Topic No. 8.2)**
   (b) Explain their applications in various fields. **(Unit-VIII, Topic No. 8.2)**

SOLUTIONS TO APRIL/MAY-2013, SET-3, QP

Q1. (a) By means of simple diagrams representing the hole and shaft, show the essential conditions for,

(i) Clearance fit

(ii) Interference fit.

Give practical example for each.

Answer : **April/May-13, Set-3, Q1(a)**

(i) Clearance Fit

For answer refer Unit-I, Q11, Topic: Clearance Fit.

Examples

1. Tail stock spindle in a lathe.
2. Feed movement of the spindle quil in a drilling machine.
3. Piston, slide values, spigots, spindle of lathe and dividing heads.

(ii) Interference Fit

For answer refer Unit-I, Q11, Topic: Interference Fit (Exclude Sub Topics).

Examples

1. Steel tyres on railways car wheels.
2. Gears on the intermediate shaft of trucks.
3. Bushing in the gear of a lathe head stock.
4. Pump impeller on shaft.
5. Drill bush in jig plate and cylinder linear in block etc.,

For remaining answer refer Unit-I, Q11, Figure: Possible Size Relationships Between a Hole and Shaft.

(b) A steel shaft is made within limits on its diameter of 60.02 and 50.96 mm. State the upper and lower limits of bore size of a bush to give a maximum clearance of 0.1 mm and minimum clearance of 0.02 mm.

Answer : **April/May-13, Set-3, Q1(b)**

Given that,

Upper limit of shaft diameter = 60.02 mm

Lower limit of shaft diameter = 50.96 mm

Maximum clearance = 0.1 mm

Minimum clearance = 0.02 mm

We know that,

Maximum clearance = Upper limit of bore – Lower limit of shaf.

$\Rightarrow$ 0.1 = Upper limit of bore – 50.96

$\Rightarrow$ Upper limit of bore = 0.1 + 50.96

$\therefore$ Upper limit of bore = 51.06 mm

And,

Minimum clearance = Lower limit of bore – Upper limit of shaft.

$\Rightarrow$ 0.02 = Lower limit of bore – 60.02

Lower limit of bore = 0.02 + 60.02

$\therefore$ Lower limit of bore = 60.04 mm

Q2. Discuss the procedure of subdivisions of the end standard by Brooke's level comparator.

Answer : **April/May-13, Set-3, Q2**

A Brooke's level comparator consists of spirit level, balls, revolving tables, etc., as shown in figure,

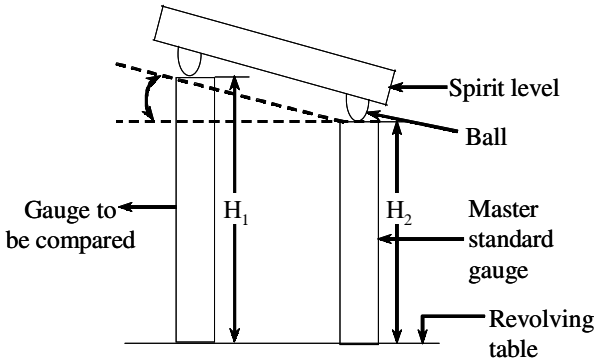


Figure: Brookes Level Comparator

Procedure of Subdivision of the End Standard by Brookes Level Comparator

(i) The gauge to be compared with standard gauge is placed on the revolving table.

(ii) A spirit level is placed on the two gauges as shown in figure.

(iii) The two gauges are positioned and the reading of the bubble of spirit level is noted.

(iv) Then, the table is rotated by 180º such that the two gauges interchanges their position and the value of the bubble of spirit level is noted.

(v) The two readings are calibrated and if the difference in the reading are observed then, it is calculated by using the formula i.e.,

$$\text{Difference of gauges reading} = \frac{\text{Height of gauge to be measured} - \text{Height of standard gauge}}{2}$$

$$= \frac{H_1 - H_2}{2}$$

(vi) The position of the two gauges will be same before and after the interchange because, they are fixed.

(vii) The readings can be accurate if the comparator gauges are measured at room temperature i.e., 20ºC.

(vii) Thus, the brookes level comparator is used for calibration of gauges.

Q3. (a) Discuss about the following terms related to testing of optical flat?

(i) Flatness test

(ii) Parallelism test.

Answer : **April/May-13, Set-3, Q3(a)**

(i) Flatness Test

For answer refer Unit-III, Q11.

(ii) Parallelism Test

In optical flat, parallelism test is conducted on *B* type optical flats by using Fizean interferometer techniques as shown in the figure,

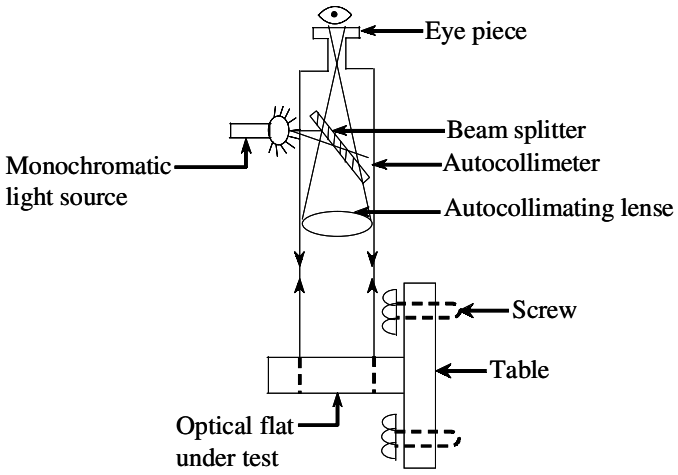


Figure: Parallelism Test of Optical Flat

It consists of a mercury vapour lamp, beam splitter, collimating lens, optical flat and a table with screw levelling arrangement.

Initially, the light from the mercury vapour lamp is focussed on to an opening in the eye piece which gets reflected partially through the beam splitter, strikes the collimating lense and flat plate which is to be tested. The flat plate is located on a table which can be adjusted to any position by tightening the screws. Finally, the beam retraces its path after getting reflected from the two surfaces. As a result, the interference fringes are formed and can be observed from the eye piece of an autocollimeter. These fringes are used to calculate the degree of flatness of two surfaces of flat plat.

Let,

μ – Refractive index of substance

λ – Wavelength of light.

$\therefore$ Difference of thickness of flat at two points on adjacent fringes = $\frac{\lambda}{2} \times \frac{1}{\mu}$ microms.

From the above relation, the optical parallelism of two surfaces of flat can be obtained.

(b) Write a note on the care to be taken in the use of optical flat.

Answer : **April/May-13, Set-3, Q3(b)**

For answer refer Unit-III, Q24, (Last Paragraph from : Practicing the use of optical flats ---- till end of the answer).

Q4. (a) Show the schematic representation of roughness on machined components.

Answer : **April/May-13, Set-3, Q4(a)**

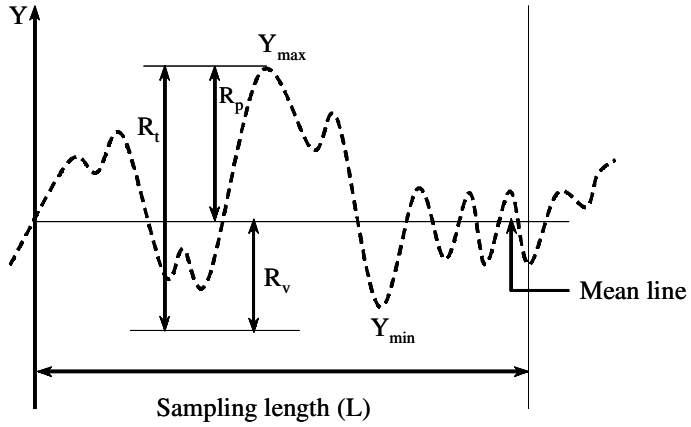


Figure: Schematic Representation of Roughness on Machined Component

Where,

R_t – Maximum peak to valley height

R_p – Maximum peak to mean height

R_v – Mean to valley height.

(b) Explain the terms form factor and bearing area curve.

Answer : **April/May-13, Set-3, Q4(b)**

The terms form factor and bearing area curve are usually used to estimate the surface texture.

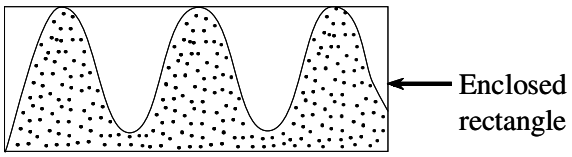
Form Factor

It is defined as the limited area that carries the load at each surface of the section. It can be determined by measuring the area of the material above the base line which is selected randomly and the enclosed rectangle area.

Form factor also determines the degree of fullness which is denoted by symbol (k) and degree of emptiness, denoted by symbol (k_p).

$$\text{Degree of fullness } (k) = \frac{\text{Area of the material}}{\text{Area of enclosed rectangle}}$$

Degree of emptiness $(k_p) = 1 - k$



Figure

Bearing Area Curve

For answer refer Unit-IV, Q6, Topic: Form Factor or Bearing Curve Method.

Q5. (a) Name the important dimensions of V- thread which control the fitting of threads.

Answer : **April/May-13, Set-3, Q5(a)**

For answer refer Unit-V, Q4.

(b) Explain why it is essential to measure/gauge the different elements of any screw thread.

Answer : **April/May-13, Set-3, Q5(b)**

For answer refer April/May-13, Set-1, Q5(b).

Q6. (a) Explain the tests for the flatness of bed and for the straightness and parallelism of bed ways of a lathe machine.

Answer : **April/May-13, Set-3, Q6(a)**

For answer refer Unit-VI, Q5, Topic: Test for Level of Installation.

For answer refer Unit-VI, Q6, Topic: Parallelism of Spindle Axis and Bed.

(b) Explain the tests for the true running of the headstock centre.

Answer : **April/May-13, Set-3, Q6(b)**

For answer refer Unit-VI, Q8(ii).

Q7. (a) Explain various methods with neat sketches, generally used for measuring the gear tooth thickness.

Answer : **April/May-13, Set-3, Q7(a)**

For answer refer Unit-VII, Q18.

(b) Describe suitable methods for testing the important geometric features of a ground 'Master' gear.

Answer : **April/May-13, Set-3, Q7(b)**

For answer refer April/May-13, Set-1, Q7(b).

Q8. (a) Explain the different types of surface modification process.

Answer : **April/May-13, Set-3, Q8(a)**

For answer refer Unit-VIII, Q8.

(b) Explain their applications in various fields.

Answer : **April/May-13, Set-3, Q8(b)**

For answer refer April/May-12, Set-3, Q8(b).