

III B. Tech I Semester Regular Examinations November - 2015

METROLOGY

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

- Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
 2. Answering the question in **Part-A** is compulsory
 3. Answer any **THREE** Questions from **Part-B**

PART -A

- 1 a) Name and sketch three main types of fits. [3M]
- b) Explain the various standards of linear measurement. [4M]
- c) What are the advantages of optical instruments over conventional measuring instruments? [4M]
- d) What is the importance of surface roughness? Mention the geometrical characteristics of a surface. [4M]
- e) Explain how various elements of screw thread are measured. [3M]
- f) Distinguish between alignment tests and performance tests on machine tools. [4M]

PART -B

- 2 a) Determine limit dimensions for a clearance fit between mating parts of diameter 40 mm, providing a minimum clearance of 0.10 mm with a tolerance on the hole equal to 0.025mm and on shaft 0.05mm using both systems. [6M]
- b) On what factors the variation in size depends in any manufacturing process? [4M]
- c) Differentiate between interchangeable assembly and selective assembly, with suitable examples. [6M]
- 3 a) Distinguish between line and end standards. How are end standards derived from line standards? Give examples. [4M]
- b) Discuss with suitable sketches, the method for testing for straightness by using spirit level and autocollimator. [8M]
- c) Select the sizes of angle gauges needed to build the following angles: $22^{\circ}11'20''$, $29^{\circ}54'$, $31^{\circ}49'24''$. [4M]
- 4 a) Explain the principle of measurement by light wave interference method. [4M]
- b) With the help of neat sketch explain the working principle of a tool maker's microscope. [6M]
- c) Describe the working of a profile projector. What are its applications? [6M]
- 5 a) Describe various methods of numerical assessment of surface finish. [4M]
- b) Describe with a neat sketch the construction, principle and operation of Talysurf. [6M]
- c) Differentiate between surface roughness and waviness. [6M]



- 6 a) With a neat sketch illustrate how the effective diameter of a screw thread may be checked using the three wire method. [6M]
b) Describe a gear tooth Vernier and indicate how the tooth thickness is checked with this instrument. [5M]
c) Describe the pitch measurement of internal screw threads by various methods. [5M]
- 7 a) Explain how a precision level can be used to determine the flatness and straightness of machine beds. [6M]
b) Explain in detail with suitable sketches about various alignment tests performed on a lathe. [10M]

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PART -A

- 1 a) Define basic size, deviation, upper and lower limit of size. [3M]
- b) What are the requirements of a good dial indicator? What are the advantages of it? [4M]
- c) Sketch the various patterns of interference bands observed in the following cases: [4M]
(i) Perfect flat surface (ii) Convex shape (iii) Concave shape and (iv) Gauge block with rounded edges.
- d) Mention the basic requirements of a comparator. [3M]
- e) Enumerate various screw thread parameters for metrological measurement. Also enlist instruments corresponding to their measurements. [4M]
- f) Describe a method to find out the flatness of surface plate. [4M]

PART -B

- 2 a) Distinguish between hole basis system and shaft basis system. [5M]
- b) In a hole & shaft assembly of 30mm nominal size the tolerances are specified as [6M]
Hole $30_{-0.01}^{+0.02}$ Shaft $30_{-0.070}^{-0.040}$, Determine i) Maximum & Minimum clearance obtainable ii) Hole & Shaft Tolerance and iii) Type of fit it is?
- c) Discuss in detail the salient features of the systems of limits and fits as per Indian standard. [5M]
- 3 a) Explain Taylor's Principle as applicable to limit gauging with sketches. [4M]
- b) Explain the construction and use of (i) Vernier bevel protractor, (ii) Angle dekkor and (iii) Sine bar with suitable sketches. [8M]
- c) Explain the method of calibration of slip gauges. [4M]
- 4 a) Describe the working of NPL flatness interferometer with a neat sketch. [6M]
- b) Explain why monochromatic light is used for Interferometry work and not the white light. [4M]
- c) Explain how flatness errors of lapped surfaces are measured with an optical flat. [6M]
- 5 a) With the help of neat sketch explain the working principle of a reed type mechanical comparator. [8M]
- b) Indicate how various surface roughness specifications are placed relative to the symbol. [4M]
- c) Describe the working principle of profilograph. [4M]



- 6 a) What is 'best size of wire' for effective diameter measurement? Derive a relationship for the best size wire in terms of its effective diameter. [6M]
b) Describe with the help of a neat sketch the working principle of Gear tooth vernier caliper. [6M]
c) Describe the following terms in screw threads: [4M]
(i) Major diameter, (ii) Minor diameter, (iii) Tooth thickness and (iv) Pitch
- 7 a) What is flatness? What are the various methods of checking flatness of surfaces? [9M]
b) Describe how you would perform alignment tests on drilling machine. [7M]

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PART -A

- 1 a) How tolerances are specified and indicated? [3M]
- b) What is limit gauging? Sketch the different limit gauges used in industry for quality checking. [4M]
- c) What are the important uses of optical projectors? [4M]
- d) Explain the following terms with reference to surface roughness measurement: [3M]
(i) CLA value (ii) Maximum peak to valley height (iii) Sampling length.
- e) Differentiate between simple effective diameter and virtual effective diameter of an external screw. [4M]
- f) Enlist the instruments and equipment essential for performing alignment tests. [4M]

PART -B

- 2 a) Differentiate between unilateral and bilateral tolerance with examples. [4M]
- b) Determine the dimensions and tolerances of the shaft and hole having the size of 25H7/f8. 25mm falls in diameter steps of 18-30. Also indicate the type of fit and show the tolerances with sketch. [8M]
Assume the following data,
The fundamental deviation for shaft 'f' is $-5.5D^{0.41}$,
The standard tolerance unit $i=0.45 D^{1/3}+0.001D$, where D is the geometric mean of the lower and upper limits of diameter step in which the diameter consideration lies, D is in mm,
The standard tolerance for IT7=16i and IT8=25i.
- c) Explain the need for providing tolerance on a dimension. [4M]
- 3 a) With the help of sketches explain the working of an external micrometer. [5M]
- b) Explain the need for gauge maker's tolerance. Discuss how the wear allowance is provided on gauges. [6M]
- c) Describe the types of spirit levels used in metrology. Define sensitivity and level constant of a spirit level. [5M]
- 4 a) What is the difficulty in using the optical flat alone? How do you overcome this difficulty in an interferometer? [5M]
- b) Describe with a neat sketch working principle of a Michaleson's interferometer. [6M]
- c) Describe with a neat sketch working principle of a Autocollimator. [5M]



- 5 a) What are the advantages, uses and disadvantages of electrical comparators? [6M]
b) What are various orders of geometrical irregularities on surfaces? How these are classified? [4M]
c) The heights of peaks and valleys of 20 successive points on a surface are 35, 25, 40, 22, 37, 19, 41, 21, 42, 18, 42, 24, 44, 25, 40, 18, 40, 18, 39, and 21 microns respectively, measured over a length 20mm. Determine CLA and RMS values of roughness surface. [6M]
- 6 a) With neat sketches explain the working of a Rolling gear tester. [6M]
b) Discuss on angle of thread, thread pitch, and profile thread gauges. [6M]
c) Explain about total composite error and tooth to tooth composite errors. [4M]
- 7 a) Explain with suitable sketches the various alignment tests performed on Milling machine. [10M]
b) Explicate the utility of straight edge and surface plate in laboratories. [6M]

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PART -A

- 1 a) Differentiate between allowance and tolerance. [3M]
- b) Sketch a double ended plug gauge and progressive plug gauge. What are the advantage and disadvantages of one over the other? [4M]
- c) Describe the use of optical flats and monochromatic light for dimensional comparison. [4M]
- d) Explain how CLA index number is determined. [3M]
- e) Describe the tooth thickness measurement with flange micro meter. [4M]
- f) What is the effect upon the work if tail stock center line is parallel to but slightly above the head stock spindle axis? [4M]

PART -B

- 2 a) Bring out the salient features of British standard and ISO systems of limits and fits. [4M]
- b) Calculate the limits of hole and shaft in the hole and shaft pair designated by 40H7/d8, Assume (i) 40 lies in diameter step of 30 and 50 (ii) The standard tolerance unit i (microns) = $0.45 D^{1/3} + 0.001D$, where D is the geometric mean of the lower and upper limits of diameter step in which the diameter consideration lies, D is in mm (iii) The fundamental deviation for shaft $d = -16 D^{0.44}$, (iv) The standard tolerance for IT7=16*i* and IT8=25*i*. [8M]
- c) Discuss on causes of variation of size of a component occur in the process of manufacture. [4M]
- 3 a) Discuss the concept of wringing of slip gauges. [3M]
- b) Design the general type GO gauges and NOGO gauges for components having 20H7/f8 fit. Given Gauge tolerance = work tolerance = 10% of work tolerance. Assume the data following:
Upper deviation of shaft 'f' is $-5.5D^{0.41}$,
The standard tolerance unit $i = 0.45 D^{1/3} + 0.001D$, where D is the geometric mean of the lower and upper limits of diameter step in which the diameter consideration lies, D is in mm,
20mm falls in diameter steps of 18-30mm
The standard tolerance for IT7=16*i* and IT8=25*i*. [8M]
- c) Briefly explain with neat sketches of (i) Profile Gauge (ii) Plug Gauge. [5M]



- 4 a) Discuss the applications of optical projectors for precision measurements. [4M]
b) Describe with a neat sketch working principle of a NPL gauge interferometer. [6M]
c) What are the numerous fringe contours in checking slip gauges by means of optical flats? Describe the method of experimental testing of such surfaces. [6M]
- 5 a) Discuss the following terms in connection with surface finish measurement: [4M]
(i) Waviness, (ii) Lay, (iii) Roughness, (iv) Centre line profile.
- 6 b) Describe the working principle of a solex pneumatic comparator. [7M]
c) Describe the working principle of an electronic comparator. [5M]
- 6 a) Explain the method to check involute profile of a screw thread. [5M]
b) Explain the method of checking the thread form and angle. [4M]
c) With a neat sketch explain how the simple effective diameter of a screw thread may be checked using the two wire method. [7M]
- 7 a) What is a principle of autocollimator? Discuss on applications of autocollimator? [6M]
b) Differentiate geometric and practical tests on machine tools. [6M]
c) What is the effect on the work, if the center T slot of a horizontal milling machine is not square with the spindle axis? [4M]

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