# METROLOGY & INSTRUMENTATION – II Test

Time: 60 minutes Maximum marks: 50

Explain the steps clearly, for problems. Answer only to the point.

1) Answer all questions.
   a) Explain the working of a Digital to Analog Converter that uses a weighted resistor network.
   b) Explain the characteristic curves of pneumatic displacement transducers.
   c) What is the meaning of the following symbol on a drawing? Explain how will you determine its value?

| | |
|---|---|
| / | 0.03 |

   d) What do you mean by structured lighting? Show how it can help measure the height of a rectangular block.

(4X5=20 marks)

2) Answer part a) or part b).
   a)
      i) An aircraft wing oscillates during flight at a frequency of 2Hz. A Digital Acquisition System is used to sample the displacement at a frequency of 2.4Hz for a period of 2 minutes. What will be the frequency indicated by the DAS? Determine the frequency resolution.
      ii) The diameter of an ISO Metric Thread of pitch 5mm was measured over three wires of size 3.1mm was found to be 101.48mm. Calculate the effective diameter of the thread.
      iii) Determine the limits of size for a shaft designated as 25e8. The upper deviation for e in μm is given by $-11D^{0.41}$ where D is in mm, while the tolerance range for IT8 is 25i.

(3 X 5 =15 marks)

**OR**

   b)
      i) The length of a 6mm gauge block when measured on an absolute length interferometer gave the following results:

| Radiation wavelength μm | 0.6438 | 0.5086 | 0.4800 | 0.4678 |
|---|---|---|---|---|
| Observed fraction | 0.64 | 0.57 | 0.42 | 0.42 |

      Determine the true size of the gauge block.
      ii) An autocollimator has a lens of focal length 100mm. If the reflector, which is placed 500mm from the lens, is rotated by an angle of 10' with respect to the autocollimator axis, determine the corresponding displacement of the cross-wire image.
      iii) For a $20^o$ pressure angle gear having 48 teeth and 4mm module, calculate a) Plug diameter b) Distance over plugs spaced 16 teeth apart

(3 X 5 =15 marks)

3) Answer part a) or part b).
   a)
      i) A set of angle gauges contain the sizes $1^o$, $3^o$, $9^o$, $27^o$, $41^o$, 1', 3', 9', 27', 3", 6", 18"& 30". Choose a combination of gauges to set up an angle of $21^o8'24"$.

(4 marks)

      ii) A CMM touch trigger probe was made to touch the two measuring faces of a slip gauge of size 25.000mm in a direction normal to the faces. The following readings were obtained for the centre position of the stylus having a diameter of 3.012mm:

| Point | x coordinate | y coordinate | z coordinate |
|---|---|---|---|
| 1 | 105.367 | 52.671 | 12.387 |
| 2 | 90.432 | 29.199 | 12.387 |

      Determine the effective diameter of the stylus.

(7 marks)

      iii) Explain how the displacement direction is determined in an LVDT.

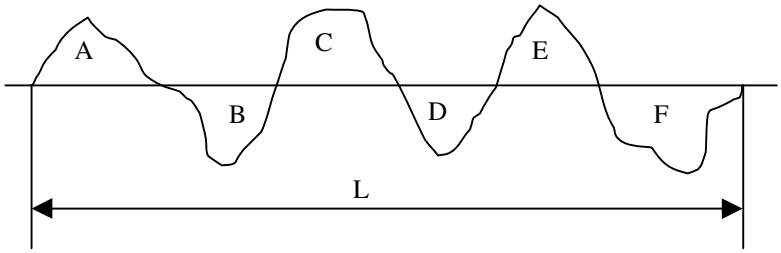
(4 marks)

**OR**

   b)
      i) The outer diameter of an aluminium shaft was measured using a micrometer of steel and found to be 249.32mm. The temperature of the shop was around $30^oC$. Estimate the true

diameter of the shaft if the coefficients of expansion of aluminium and steel are 24 & 11.5ppm/$^{o}$C respectively.

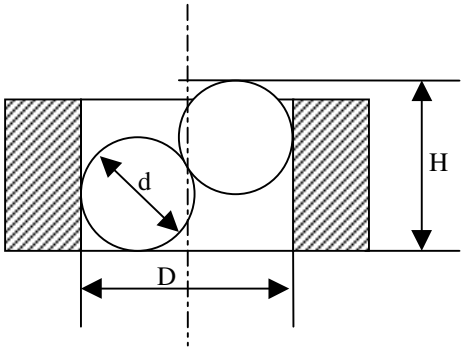
ii) The profile tracing of a turned surface is shown below.




The sampling length (L) used was 0.8mm, the vertical magnification 4000, and horizontal magnification 120. Determine the value of Ra, if the areas in mm$^2$ above and below the mean line are as follows:

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| 42 | 83 | 71 | 97 | 51 | 26 |

iii) Determine the inner diameter D of the bush shown below, if the balls are of diameter d=10mm and the height H=16.428mm.




(3 X 5 =15 marks)

**ANSWERS**

1)

2)

a)

i) N = 2 X 60 X 2.4 = 288

$\delta f = fs/N = 2.4 / 288 = 0.00833Hz$

b)

i) 6000.1μm

ii)

iii)

3)

a)

i)

ii) 27.82

iii)

b)

i)

ii)

iii)