

Metrology and Quality Assurance (MCL134)

Part A Metrology

Max. Marks 20

Total time allotted is 120 (actual exam time) +15 (uploading time) = 135 minutes. Uploading should be done before 11:45 am on the day of the exam which is 16th November, 2021.

All questions are compulsory. All parts of the same question have to be answered at one place only. You may assume realistic values of any missing data in problems if required.

1. Three 200 mm gauges to be calibrated are measured on a level comparator by wringing them together and then comparing them with a 600mm gauge. The 600mm gauge has an actual length of 600.0025mm, and the three gauges together have a combined length of 600.0035 mm. When the three gauges are intercompared, it is found that gauge A is longer than gauge B by 0.0020mm but shorter than gauge C by 0.001mm. Determine the length of each gauge. 2
2. Draw a neat sketch of a progressive type of snap gauge and explain its working principle. A 40mm shaft and hole pair is designated as 40 H8/d9, given that (a) IT8 = 25i, (b) IT9 = 40i (c) upper deviation of shaft = $-16D^{0.44}$? 1+1=2
3. What is a spirit level and explain how it can be used for straightness measurement using suitable sketch? With suitable sketch explain how the squareness between an axis and a plane be measured. 1.5+1.5=3
4. Explain the working principle of a Taylor Hobson make talysurf. What is the function of the springs as used in a Tomlinson surface meter. 1.5+0.5=2
5. How is the magnification obtained in a dial indicator? Distinguish between Zeiss ultra-optimeter and simple optical comparator with sketches. 0.5+1.5=2
6. The fringe patterns shown in Fig. 1 were observed for four different specimens when viewed through an optical flat. Give your assessment about the nature of surface conditions for each of the cases. 2

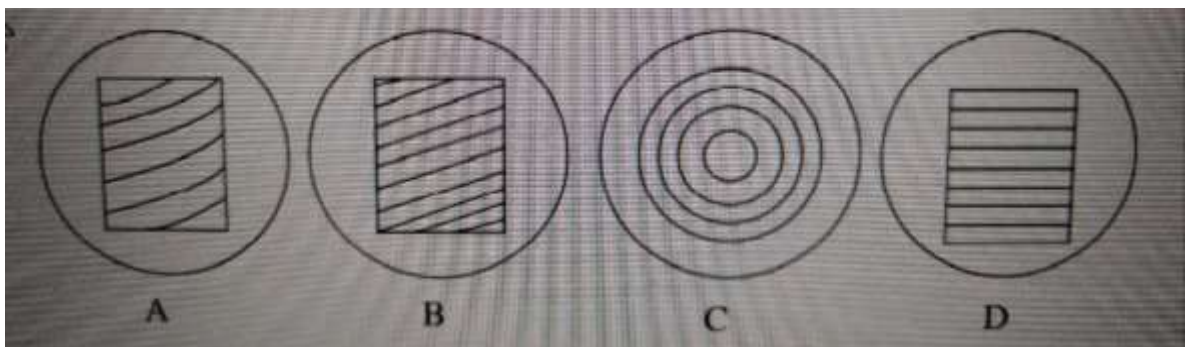


Fig. 1 Fringe patterns viewed through the optical flat

7. With neat sketch show how the best size wire in context of measurement of pitch diameter of a thread is obtained. Why the length of the Go portion of a plug screw gauge is larger than that of the NO Go portion. 0.5+0.5= 1
8. A metric screw thread is being inspected using the two-wire method in order to measure its effective diameter and the following data is generated: Pitch = 1.25mm, diameter of the

best-size wire = 0.722mm, and distance over the wires = 25.08mm. Determine the effective diameter of the screw thread. The correction factor P may be taken as 0.36. 1

9. In the measurement of surface roughness, the values of 20 successive peaks and valleys were measured from a datum and were found to 35, 25, 40, 22, 35, 18, 42, 25, 35, 22, 36, 18, 42, 22, 32, 21, 37, 18, 35, 20 microns. Determine the value (in microns) of R_a . Explain how it is possible to distinguish between two mirror surface using roughness parameter. 1+1=2
10. Explain with neat sketch how the flatness of a surface may be obtained. 2
11. Explain whether it is advisable to use a vision system for measuring the various geometrical features of a product. 1

Part B Quality Assurance

SUBJECT: MCL 134 (Quality Assurance Part)

MAX MARKS : 20

Q 1. Differentiate between:

- a) Chance causes **and** Assignable causes
- b) Hypergeometric **and** Poisson distributions
- c) Average outgoing quality limit **and** Average total inspection

6 marks

Q 2. Twenty five feet reels of wire are wound automatically from a continuous source of wire. The standard deviation for the cutting operation has been found to remain constant at 0.50 ft. Reels are checked every hour in subgroups of size nine. The user of these reels has purchase specification of 25 ± 1 feet, but he is really concerned about short reels.

- a) What target value should be set by the manufacturer to ensure that 99.9% of the reels meet the minimum specification?
- b) What is the probability of Type II error for \bar{X} chart if the process average increases by 1% above the target value?

1+3 = 4 marks

Q 3. Specifications require that a certain quality characteristic of a manufactured product must have a minimum value of 200 units. This quality characteristic can be tested only by a destructive test. The product is made in batches of several thousands. The past practice regarding acceptance inspection has been to test four articles from each batch. If all the four articles met the quality specification of 200, the batch was accepted. If two or more failed, the batch was rejected. If one failed, a second sample of four was taken; with no failures on the second sample, the batch was accepted; otherwise it was rejected.

a) What is the probability that a batch containing 5% defective items will be accepted by this procedure? Use suitable probability distribution of no. of defectives.

b) How would you plot OC Curve of the plan?

4+1 = 5 marks

Q 4. Annual production of a certain part is 100,000 and it is made in lots of 2000. Average percent defective of the process is 1.8%. It is required to compare the economy of

- i) 100 % inspection, ii) No inspection iii) Single sampling plan : $n = 100$, $A_c = 2$.

Unit cost of inspection is 0.15. Average cost of replacing an item (reworking + scrapping) found defective during inspection is 1.50. Any defective part entering the assembly department will be finally discovered and eliminated at an estimated cost of 15.0 per part. **Compare all the three options on the basis of costs of quality.**

State the assumption made.

5 marks