



UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET

COURSE CODE	: DTM 2122
COURSE	: ENGINEERING METROLOGY
SEMESTER/SESSION	: 1-2023/2024
DURATION	: 2 HOURS

Instructions:

1. This booklet contains 5 questions. Answer **all questions**.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise your hands and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 8 PRINTED PAGES INCLUDING COVER PAGE

ENGINEERING METROLOGY (DTM 2122)

QUESTION 1

Engineering metrology is crucial for maintaining accuracy in manufacturing and mechanical components. Coordinate Measuring Machine (CMM) is one of the equipment used in metrology and measurement.

- a) **Give** four (4) objectives of engineering metrology. (4 Marks)

- b) **Sketch** the schematic diagram for:
 - i. Accurate but not precise (2 Marks)
 - ii. Precise but not accurate (2 Marks)
 - iii. Accurate and Precise (2 Marks)

- c) **Give examples** three (3) types of CMM. (3 Marks)

- d) **Predict** three (3) potential characteristics of CMM. (3 Marks)

- e) **Classify** four (4) applications of CMM. (4 Marks)

QUESTION 2

Two broad categories of errors in measurement have been identified as systematic and random errors.

- a) **Predict** three (3) possible sources of error in measurements. (6 Marks)
- b) Based on the provided situation, **choose** whether the error is systematic or random. (6 Marks)
- 1) If you repeat the experiment, you'll get the same error.
 - 2) Operator's inability to note the readings because of fluctuations during measurement.
 - 3) This error is an unpredictable and can't be replicated by repeating the experiment again.
 - 4) Error in operator's judgment in reading the fractional part of engraved scale divisions.
 - 5) The errors of the apparatus you use to measure.
 - 6) The errors are things that affect your measurement such as temperature change.
- c) **Differentiate** between systematic error and random error. (8 Marks)

QUESTION 3

Gauges come in various forms, depending on the specific application and the type of measurement required

- a) **Discover** types of gauges. (3 Marks)
- b) **Sketch** a gauge block and discover its function. (3 Marks)
- c) Figure 1 depicts an inspection instrument used to compare the permitted tolerances of a workpiece. **Interpret** its concept. (6 Marks)

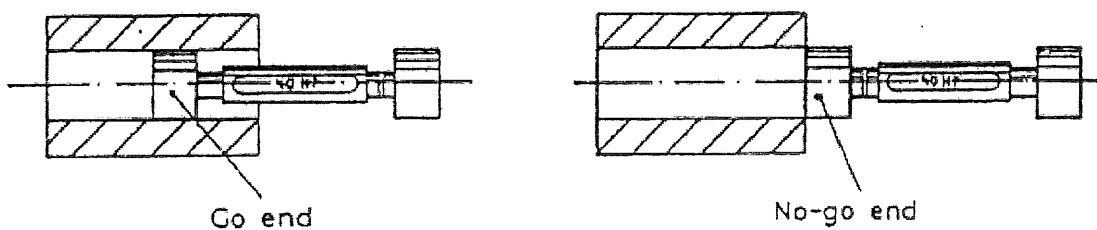


Figure 1: Inspection Process using Plug Gauge

- d) A thickness gauge is a type of gauge used to measure the thickness of a material or object.
 - i. **Sketch** a thickness gauge. (3 Marks)
 - ii. **Produce** the working procedures for handling thickness gauges. (5 Marks)

QUESTION 4

Precision measuring instruments and machines are essential tools used to ensure accurate and reliable measurements in various industries, enabling precise and high-quality manufacturing processes.

- Give three (3) advantages of digital measuring instruments. (3 Marks)
- Interpret comparison between direct reading and indirect reading. (4 Marks)
- Figure 2 illustrates a schematic diagram of an outside micrometer. Predict the names of parts P, Q, R, and S accordingly. (4 Marks)

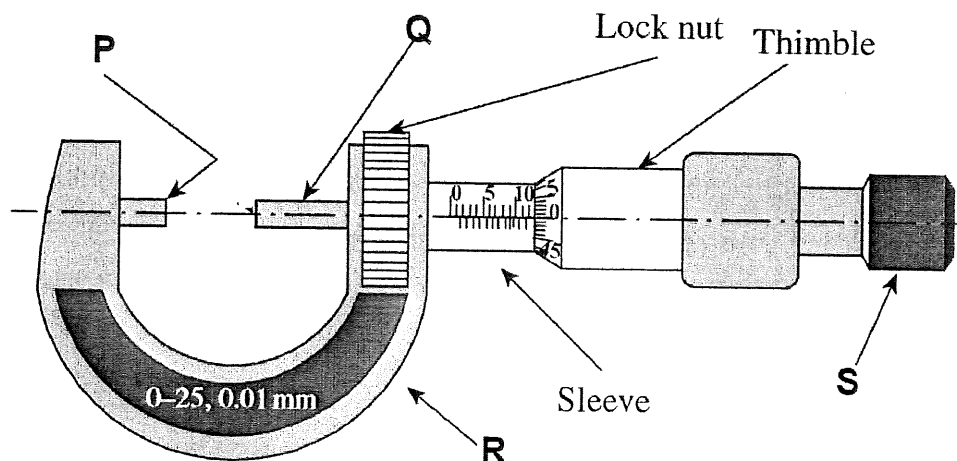


Figure 2: Outside Micrometer

- Figures 3, 4 and 5 show readings for three different measuring instruments. Solve the reading value (metric) shown for each figure:

ENGINEERING METROLOGY (DTM 2122)

i. Vernier Caliper

(3 Marks)

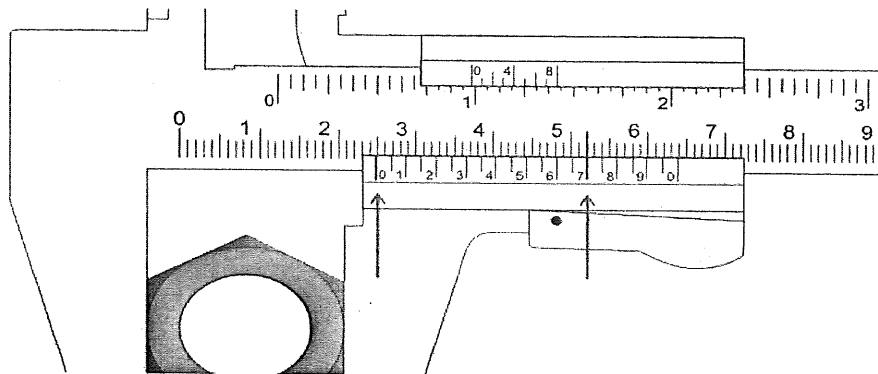


Figure 3: Vernier Caliper Reading

ii. Micrometer

(3 Marks)

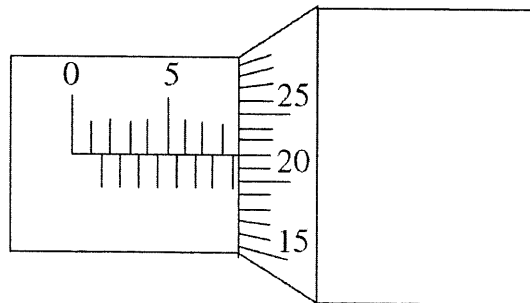


Figure 4: Micrometer Reading

iii. Caliper

(3 Marks)

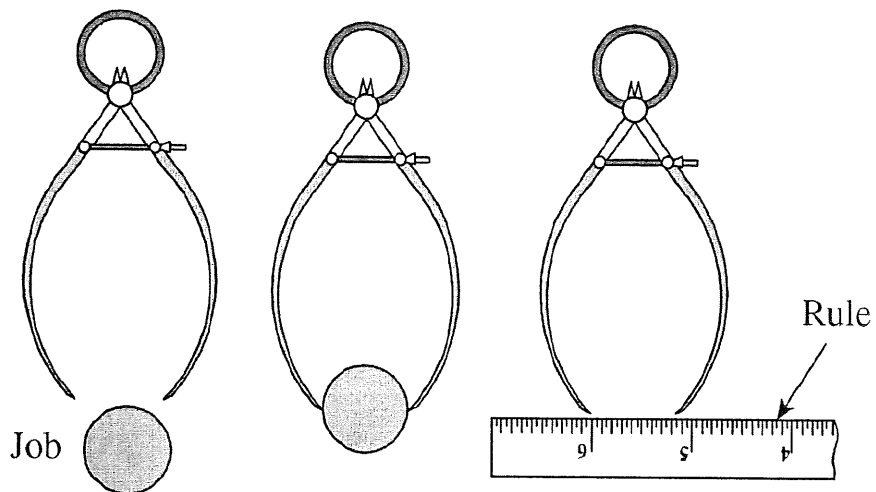


Figure 5: Caliper Reading

QUESTION 5

Limit and fit are used to define tolerances for mating parts.

a) **Define** the term:

- i. Limit (1.5 Marks)
- ii. Fit (1.5 Marks)

b) **Classify** three (3) types of fits. Then, **choose** any one (1) type of fit and briefly explain. (5 Marks)

c) **Solve** the following basic hole system problem:

Given the maximum clearance is 0.007mm. If minimum diameter of shaft is 5.246mm while hole and shaft have tolerances of 0.003mm and 0.002mm respectively, determine:

- i. Maximum diameter of hole (3 Marks)
- ii. Minimum diameter of hole (3 Marks)
- iii. Maximum diameter of shaft (3 Marks)
- iv. Minimum clearance (3 Marks)

APPENDIX**Formula**

1. Max clearance = Max \emptyset Hole – Min \emptyset Shaft
2. Tolerance (Shaft) = Max \emptyset Shaft – Min \emptyset Shaft
3. Min. Clearance = Min \emptyset Hole – Max \emptyset Shaft
4. Tolerance (Hole) = Max \emptyset Hole – Min \emptyset Hole

----- End of Questions -----