



MACHAKOS UNIVERSITY

University Examinations for 2020/2021 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

EMM 305: METROLOGY

DATE: 9/8/2021

TIME: 2.00-4.00 PM

INSTRUCTIONS

Answer question ONE and any other two questions.

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Enumerate **FOUR** main concerns metrology addresses in engineering (4 marks)
- b) List **FOUR** elements of measuring system as applied in metrology. (4 marks)
- c) Using a neat sketch, illustrate the working principle of a sine centre. (5 marks)
- d) Describe **THREE** ways in which threads may be classified giving **TWO** examples in each case. (6 marks)
- e) Figure **Q1** shows a pulley assembly. Using the data sheet **BS 4500A**, calculate the working limits of the different parts in the assembly. (11 marks)

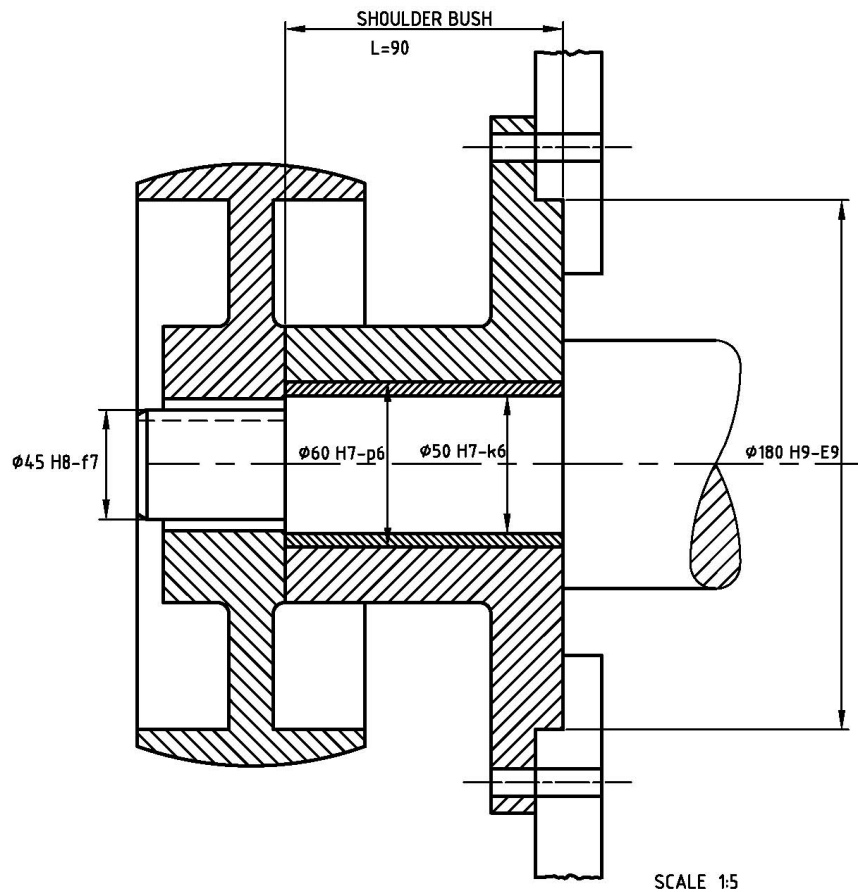


Figure Q1

QUESTION TWO (20 MARKS)

- Enumerate **SIX** main objectives of metrology. (6 marks)
- List and state the importance of **FOUR** types of standards grades in metrology. (4 marks)
- Highlight **SIX** characteristics of wavelength standards. (6 marks)
- Give the readings of depth micrometer screw gauge and vernier calipers shown in **Fig. Q2 (a)** and **(b)**. (2 marks)

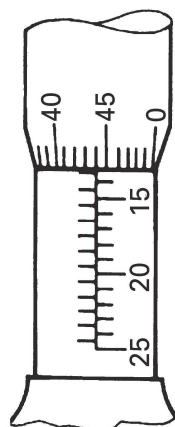


Fig. Q2 (a)

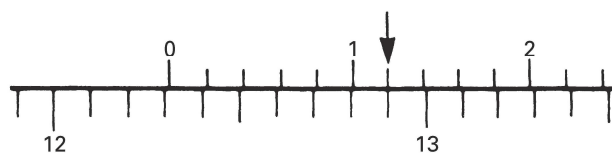


Fig. Q2 (b)

QUESTION THREE (20 MARKS)

- a) Using a neat sketch, illustrate the working principle of laser interferometer. (7 marks)
- b) List FOUR advantages of autocollimators as applied in metrology. (4 marks)
- c) Represent diagrammatically the tolerance zone of the following shaft and hole pairs and calculate the sizes of **GO** and **NOT GO** (plug and ring) gauges to inspect them. Neglect gauge tolerances.

Shaft size: $35_{-0.025}^{-0.050}$

Hole size: $35_{-0.04}^{-0.00}$

(9 marks)

QUESTION FOUR (20 MARKS)

- a) Using clear diagrams, describe the working principle of an optical bevel protractor. (5 marks)
- b) Use Table I to determine the gauge blocks to choose in order to obtain the following lengths.
 - i. 83.995 mm. (2 marks)
 - ii. 29.7575 mm. (2 marks)
 - iii. 3.9525 mm. (2 marks)

Table I: Range of Gauge Blocks.

Range (mm)	Steps (mm)	No. of pieces
1.01 – 1.49	0.01	49
0.5 - 9.5	0.5	19
25 - 100	25	4
1.0025 - 1.0075	0.0025	3

- c) Enumerate **SIX** advantages of pneumatic comparators. (6 marks)
- d) Discuss **TWO** systems utilized by mechanical comparators to amplify displacement. (3 marks)

QUESTION FIVE (20 MARKS)

- a) Enumerate **FIVE** purposes for which screw threads are used. (5 marks)
- b) Discuss **FIVE** errors found in threads briefly (10 marks)
- c) Using neat sketches, explain how minor diameter of a screw thread can be measured using external micrometer. (5 marks)