



MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

THIRD YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMM 305: METROLOGY

DATE: 24/7/2019

TIME: 2.00-4.00 PM

INSTRUCTIONS:

Answer Question One and Any Other Two Questions

QUESTION ONE (30 MARKS)

- a) Define the terms;
 - i. Metrology (2 marks)
 - ii. Measurement standard (2 marks)
- b) Briefly discuss the various types of standards used for linear measurements (12 marks)
- c) Briefly describe **TWO** supplementary units that have been added to the SI units(4 marks)
- d) List **FOUR** ways in which gauges are classified giving an example in each case(4 marks)
- e) Table below shows a slip gauge set containing several slip gauges:

S.No.	Range in mm	Steps (mm)	Number of pieces
1.	1.01 – 1.49	0.01	49
2.	1.5 - 9.5	0.5	19
3.	10,20,30,40,50,75,100	-	7
4.	1.0025,1.005,1.0075	-	3

Determine the gauge blocks to choose in order to obtain length of 46.8375mm (2 marks)

- f) Enumerate **FOUR** advantages of mechanical comparators. (4 marks)

QUESTION TWO (20 MARKS)

- a) Define the following terms with respect to metrology.
- i. Measurand (1 mark)
 - ii. Resolution (1 mark)
 - iii. Dynamic range (1 mark)
 - iv. Error (1 mark)
- b) Describe using sketches the difference between accuracy and precision. (6 marks)
- c) i) What is sensitivity? (2 marks)
- ii) The individual sensitivities of different elements comprising a temperature measuring system are:
- Transducer = $0.3 \Omega/^{\circ}\text{C}$
 - Wheatstone bridge = $0.01 \text{ V}/\Omega$
 - Amplifier gain = $80 \text{ V}/\text{V}$
 - Pen recorder = $1.2 \text{ mm}/\text{V}$

Determine the overall sensitivity and the temperature change corresponding to a recorder pen movement of 30 mm. (8 marks)

QUESTION THREE (20 MARKS)

- a) Briefly describe an autocollimator and its principle of operation. (5 marks)
- b) Briefly describe various dimensions that can be taken using a vernier calipers (6 marks)
- c) Represent diagrammatically the tolerance zone of the following shaft and hole pairs and calculate the sizes of GO and NOGO (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) Define the following terms with respect to metrology.
 - i. Repeatability.
 - ii. Traceability.
 - iii. Gauge. (3 marks)
- b) Briefly discuss **TWO** ways in which measuring instruments are classified (4 marks)
- c) A Vernier scale consists of 25 divisions on 12 mm spacing and the main scale has 24 divisions on 12 mm. What is the least count? (2 marks)
- d) Using neat sketches, explain the wringing process. (5 marks)
- e) Enumerate **FOUR** characteristics of end standards. (4 marks)
- f) List **TWO** advantages of fixed gauges. (2 marks)

QUESTION FIVE (20 MARKS)

- a) Briefly describe the principle of laser interferometry (5 marks)
- b) Discuss briefly five (5) errors found in threads (10 marks)
- c) Using a clear diagram, explain the principle of operation of an adjustable thread gauge (5 marks)