



MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

THIRD YEAR FIRST SEMESTER EXAMINATION FOR SCIENCE IN MECHANICAL
ENGINEERING

SUPPLEMENTARY EXAMINATION

EMM 305: METROLOGY

DATE: 31/8/2017

TIME: 2:00 – 4:00 PM

INSTRUCTIONS

- I. This paper contains FIVE (5) questions.
- II. Attempt ANY THREE questions.
- III. All questions carry equal 20 marks each

QUESTION ONE (20 MARKS)

- a) State the three main activities of Metrology (3 marks)
- b) Outline five requirements of comparators (5 marks)
- c) Explain the working principle of pneumatic comparator with a neat sketch, How can this gauge be used as a comparator to inspect depth of holes. (7 marks)
- d) Using neat sketches explain the principle and procedure of inspecting a spur gear tooth spacing and pitch circle diameter using the TwoWire Method. (5 marks)

QUESTION TWO (20 MARKS)

- a) Differentiate between the following terms as used in metrology (6 marks)
 - i. Measuring and testing
 - ii. Traceability chain and calibration
 - iii. Systematic and random errors

- b) Using a chart, illustrate the chain of traceability in metrology and indicate uncertainty how increases for the different levels (4 marks)
- c) Discuss the three various types of standards used for linear measurements (6 marks)
- d) Shafts of $75 \pm 0.02 \text{ mm}$ diameter are to be checked by the help of a Go and Not Go snap gauges. Design the gauge, sketch it and show the go size and Not Go size dimensions. Assume normal wear allowance and gauge markers tolerance of 0.002 and 10% respectively. (4 marks)

QUESTION THREE (20 MARKS)

- a) Define the following terms as used in metrological instruments. (4 marks)
- Range of measurement
 - Linearity
 - Sensitivity
 - Precision
- b) 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 V/V , Pen recorder= 1.2 mm/V . Determine the overall sensitivity and the temperature change corresponding to a recorder pen movement of 30 mm. (7 marks)
- c) Using a set of 78 blocks shown in the table below, show the most appropriate combination to build a length of 146.9925 mm (4 marks)

Size	Increment	No. of pieces
1.01-1.49	0.01	49
0.50 - 9.50	0.50	19
10 - 40	10.00	4
50 -100	25	3
1.0025 - 1.0075	0.0025	3
2.0	Protection blocks	2

- d) Illustrate and explain a set up for the measurement of a cone angle of a taper plug by a sine bar. (5 marks)

QUESTION FOUR (20 MARKS)

- a) State four linear measurement instruments? (4 marks)
- b) Define interferometry and explain the basic principles of a laser interferometer. (4 marks)

- c) Explain with the help of neat sketches, the principle and construction of an Angle Dekkor (7 marks)
- d) How can an autocollimator be used in checking plane surfaces such as beds of machine surfaces (5 marks)

QUESTION FIVE (20 MARKS)

- a) Define the following elements of surface (4 marks)
- Roughness
 - Waviness
 - Flaw
 - Lay
- b) Using neat sketches differentiate between true- datum or skidless instruments and Surface-datum or skid type instrument used for surface roughness measurement (6 marks)
- c) Briefly explain three effects of roughness on the performance of machined parts (4 marks)
- d) Calculate the arithmetic average and the *rms* values for the surface irregularities shown in Fig. Q5. (6 marks)

