



KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

EMM 305: METROLOGY

DATE: Friday, 20th April, 2012

TIME: 8.00 a.m. – 10.00 a.m.

INSTRUCTIONS:

Answer any **THREE** of the **FIVE** questions.

All questions carry equal 20 marks each.

Use clear and neat diagrams.

- Q.1
- a) Distinguish between measurement and gauging. (4 marks)
 - b) With the aid of sketches explain how the following gauges can be used:-
 - i) Plug gauges (standard and limit gauge)
 - ii) Ring gauges
 - iii) Adjustable caliper gauges
 - iv) Snap gauges(6 marks)
 - c) Illustrate the following readings:-
 - i) 17.87 mm of an external micrometer having an accuracy of 0.01 mm
 - ii) 57.44 mm of a vernier caliper having an accuracy of 0.02mm(4 marks)
 - d) With the aid of sketches, explain the following types of measuring errors and state the remedy for each:-
 - i) Cosine (3 marks)

ii) Parallax (3 marks)

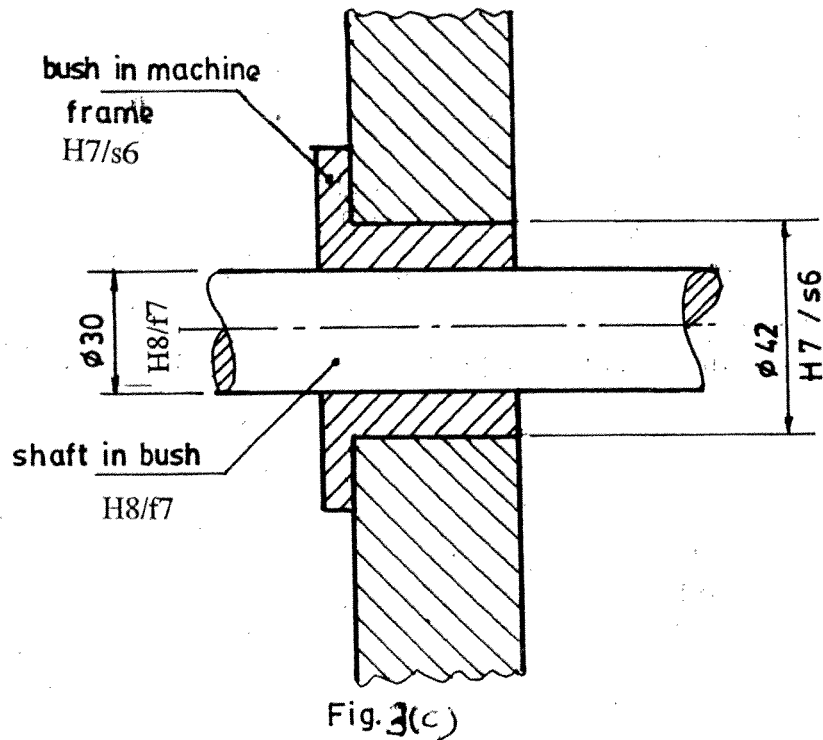
- Q.2 a) i) State three objectives of performing measurement. (3 marks)
- ii) Distinguish between errors, precision and accuracy in measurement. (3 marks)
- b) With the aid of a sketch briefly describe the international prototype meter stating the errors which can affect its accuracy. (8 marks)
- c) Explain using sketch diagrams where applicable the main causes of errors in precision or fine measurement. (6 marks)

- Q.3 i) a) Briefly explain the following terms which respect to limits and fits:-
- i) Selective assembly
- ii) Interchangeability
- ii) Distinguish the following:-
- hole basis and shaft basis tolerance method
 - Unilateral, Bilateral and Direct tolerances using sketches for external and internal contours.

(8 marks)

- b) i) Sketch diagrams to explain the maximum and minimum materials condition sizes for holes and shafts.
- ii) Illustrate the following types of fits:-
- Interference
- Clearance and transition fits
- (6 marks)
- c) Figure Q3 (c) shows an assembly of shaft, bush and machine frame. Calculate the following:-
- i) Tolerance of shaft and hole
- ii) Maximum and minimum materials condition of bush and the frame
- iii) The maximum allowance between the bush and the frame
- (6 marks)

Figure 3 shows an assembly of shaft, bush and machine frame.



- Q.4
- a) State FIVE design requirements of a comparator (5 marks)
 - b) With the aid of sketches, explain how the magnification of vertical plunger movement is accomplished on each of the following comparators.
 - i) Twisted strip
 - ii) Optical

(6marks)
 - c) A back pressure air gauging system has a linear range between values of the pressure ratio from 0.6 to 0.8, the linear relationship being represented by: $P_2/P_1 = -0.5A_m A_c + 1.1$. The control jet has 0.4mm diameter, the measurement jet 0.65mm diameter. Air is supplied at a pressure of 3 bars and the measuring indicator displaces 2mm per 10^{-3} bar change of pressure.
 - i) Show that the linear range extends over 0.025mm.
 - ii) Find the overall sensitivity of the equipment within this range

(9 marks)

- Q.5 a) i) Briefly explain why plug gauges may be unsuitable for testing the diameter of large bores. (2 marks)
- ii) Describe briefly, with the aid of a sketch, the use of a sine bar in the measurement of angle for a tapered gauge whose shape is a frustrum of a right cone. (3 marks)
- b) i) Describe the method of wringing and dismantling of slip gauges with the aid of sketches. (3 marks)
- ii) Describe, using a sketch, how the concentricity of a work piece may be tested in a workshop. (3 marks)
- c) A rectangular work piece has an overall length of 86.5125mm:-
- i) Determine the size of slip gauges to be chosen for this length of the work piece. (3 marks)
- ii) Use a suitable sketch to briefly describe how the work piece length may be tested for accuracy on a dial test indicator (d.t.i) (3 marks)
- iii) State FOUR safety precautions to be observed in the use and care of slip gauges. (3 marks)

Take: Slip gauges available:

1.01, 1.03, 1.05, 1.41, 1.44, 1.49, 05

1.5, 2.5, 3.0, 10, 20, 75mm