2501/206
TOOL ROOM PROCESSES TECHNOLOGY II
AND METROLOGY
Oct./Nov. 2022
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN MECHANICAL ENGINEERING (PRODUCTION OPTION)

MODULE II

TOOL ROOM PROCESSES TECHNOLOGY II AND METROLOGY

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
- *Answer booklet;*
- *Mathematical tables/ Scientific calculator;*
- *Drawing instruments.*

*This paper consists of **EIGHT** questions in **TWO** sections; A and B.*
*Answer **FIVE** questions taking at least **TWO** questions from each section.*
All questions carry equal marks.
Maximum marks for each part of a question are indicated.
Candidates should answer the questions in English.

This paper consists of 5 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

Turn over

SECTION A: TOOL ROOM PROCESSES TECHNOLOGY II

*Answer at least **TWO** questions from this section.*

1. (a) Describe each of the following types of chips formed in metal cutting and state **two** conditions that favour their formation:

   (i) continuous;
   (ii) segmented. (6 marks)

   (b) With the aid of a sketch, explain the forces that act at the cutting point of a cutting tool during a turning operation. (5 marks)

   (c) State **two** advantages and **two** limitations of broaching. (4 marks)

   (d) Illustrate the vertical pull up broaching. (5 marks)

2. (a) Outline the procedure for cutting a spur gear on a milling machine. (8 marks)

   (b) (i) List **three** advantages of lectrochemical machining process.
   (ii) State **two** applications of electrochemical machining process. (5 marks)

   (c) (i) Illustrate the abrasive jet machine set up.
   (ii) Explain the abrasive jet machining process. (7 marks)

3. (a) (i) List **three** advantages of centreless grinding.
   (ii) With the aid of a sketch, describe the infeed centreless grinding. (9 marks)

   (b) Illustrate each of the following types of grinding:

   (i) traverse cylindrical grinding;
   (ii) internal cylindrical grinding. (6 marks)

   (c) With the aid of a sketch describe vertical spindle rotary table surface grinder. (5 marks)

4. (a) Explain each of the following parts of a press:

   (i) die;
   (ii) upper shoe;
   (iii) back-up plate;
   (iv) stripper. (6 marks)

   (b) With aid of a sketch, describe the operation of a tripple action press. (6 marks)

   (c) (i) State **two** reasons for boring operation.
   (ii) Illustrate boring operation. (5 marks)

   (d) Illustrate grinding as a gear finishing process. (3 marks)

SECTION B: METROLOGY

*Answer at least **TWO** questions from this section.*

5. (a) Define each of the following terms as applied to gear measurement:

(i) circular pitch;

(ii) tooth thickness. (4 marks)

(b) Figure1 shows a gear tooth measurement at constant cord. Show that:

$$W = \pi M \cos 2\psi$$

and

$$h = M\left(1 - \frac{\pi}{4}\cos\psi \sin\psi\right)$$ (8 marks)

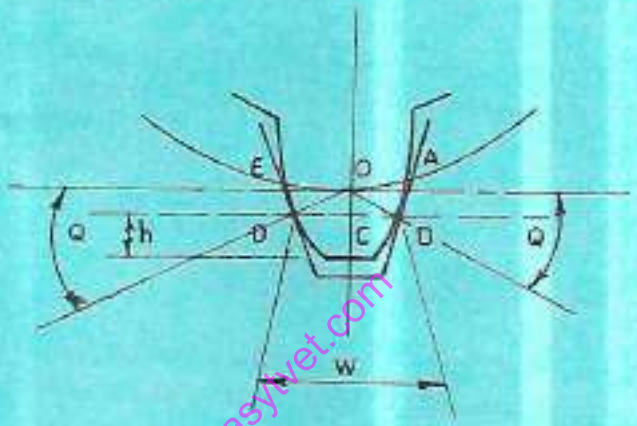


Fig.1

(c) A plug gauge and a ring gauge are to be used to check the size of a hole and shaft combination given as 48 H/k6. Use BS 4500A data sheet provided to determine:

(i) the maximum and minimum limits of both shaft and hole;

(ii) the diameters of the GO plug gauge and that of ring gauge. (5 marks)

(d) Sketch a double jaw caliper gauge. (3 marks)

6. (a) Define a comparator. (2 marks)

(b) List **three** classes of general work comparators. (3 marks)

(c) (i) List **three** requirements for a comparator to work effectively.

(ii) With the aid of a sketch, describe the construction and operation of the Johansen Mikrokator. (11 marks)

(d) A 105 mm sine bar is to be used to check the angle θ of the component shown in Figure 2 using two piles of slip gauges. One pile of slip gauge is 19.54 mm high and the other one is 40.28 mm.

(i) Illustrate the set up for checking the angle θ.
(ii) Calculate the angle θ on the component. (4 marks)

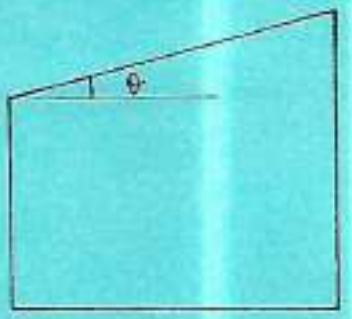


Fig 2

7. (a) Explain why white light is not suitable for interferometry. (3 marks)

(b) With the aid of a diagram, describe the constrution and operation of the NPL flatness interferemeter. (10 marks)

(c) List **three** benefits of statistical quality control. (3 marks)

(d) Explain how a quality inspector may apply statistical quality control in the course of his duty when bushes of specified tolerenaced diameters are bing produced in his workshop. (4 marks)

8. (a) Explain how control of surface texture affets the following in machined components:

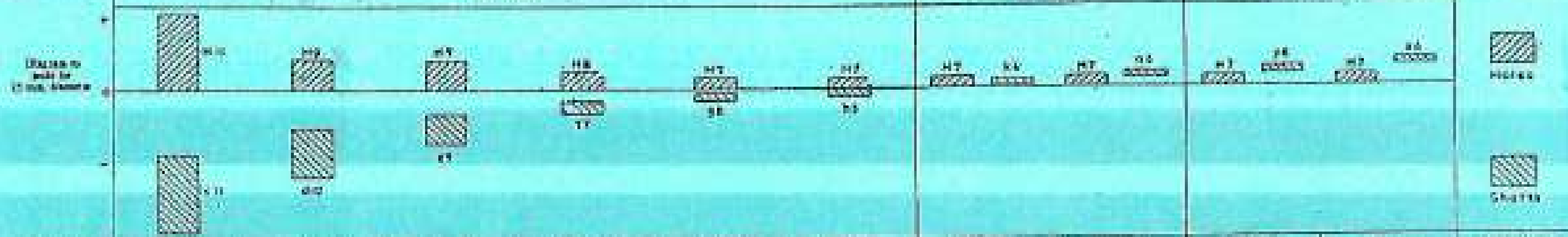
(i) fatigue life;
(ii) bearing properties. (4 marks)

(b) (i) Define standardisation.
(ii) Explain **three** benefits of interchangeability in manufacturing. (5 marks)

(c) Illustrate the set up for testing the flatness of a machined component using a dial test indicator. (5 marks)

(d) Use a sketch to determine the measurement over wires for M30 × 3.5 ISO metric thread using a 2 mm diameter wire. (6 marks)

SELECTED ISO FITS—HOLE BASIS



Nominal sizes Over mm	Nominal sizes To mm	H11 0.001 mm	c11 0.001 mm	H9 0.001 mm	d10 0.001 mm	H9 0.001 mm	e9 0.001 mm	H8 0.001 mm	f7 0.001 mm	H7 0.001 mm	g6 0.001 mm	H7 0.001 mm	h6 0.001 mm	H7 0.001 mm	k6 0.001 mm	H7 0.001 mm	n6 0.001 mm	H7 0.001 mm	p6 0.001 mm	H7 0.001 mm	s6 0.001 mm	Nominal sizes Over mm	Nominal sizes To mm
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120	140	[illegible]	[illegible]																	[illegible]	[illegible]	120	140
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355	400	[illegible]	[illegible]																	[illegible]	[illegible]	355	400
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