

2501/205
STRUCTURAL FABRICATION TECHNOLOGY,
MATERIALS AND METALLURGY II
Oct./Nov. 2022
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN MECHANICAL ENGINEERING
(PRODUCTION OPTION)
MODULE II

STRUCTURAL FABRICATION TECHNOLOGY,
MATERIALS AND METALLURGY II

3 hours

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INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet;

Drawing instruments;

Scientific calculator.

This paper consists of EIGHT questions in TWO sections; A and B.

Answer FIVE questions taking at least TWO questions from each section in the answer booklet provided.

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 4 printed pages.



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

SECTION A: STRUCTURAL FABRICATION TECHNOLOGY

Answer at least TWO questions from this section.

1. (a) Define each of the following terms as used in sheet metal industry:
- (i) pattern;
 - (ii) surface development;
 - (iii) tab. (3 marks)
- (b) With the aid of sketches, explain each of the following methods of surface development:
- (i) parallel line;
 - (ii) radial line. (8 marks)
- (c) (i) Define the term ergonomics as used in engineering design.
- (ii) State **four** ergonomic risk factors associated with welding. (5 marks)
- (d) Explain each of the following safety measures with regard to machine operations:
- (i) interlocking machine guard;
 - (ii) fail safe machine design. (4 marks)
2. (a) (i) Sketch a standard metallic roof frame and label **four** components.
- (ii) State **four** factors to consider when selecting the final solution in the design process. (12 marks)
- (b) Explain **four** types of datum used in marking out and measurement in fabrication. (8 marks)
3. (a) (i) Explain **four** components of the tungsten inert gas (TIG) welding equipment.
- (ii) Identify **two** types of tungsten inert gas welding (TIG) electrodes and state the application for of each. (8 marks)
- (b) State **four** factors that affect the quality of a weld. (4 marks)
- (c) (i) With the aid of a sketch, explain the working principle of metal inert gas (MIG) welding.
- (ii) State **two** advantages of MIG welding over other welding processes. (8 marks)



- 4.
- (a) Explain resistance welding process. (2 marks)
 - (b) Describe two types of spot welding machines. (6 marks)
 - (c) Differentiate between flash welding and butt welding as applied to resistance welding. (4 marks)
 - (d) With the aid of a sketch, describe seam welding process. (8 marks)

SECTION B: MATERIALS AND METALLURGY

Answer at least TWO questions from this section.

- 5.
- (a) Explain three precautions to be observed when undertaking a hardness test for materials. (6 marks)
 - (b)
 - (i) State five advantages of the Vicker's hardness test.
 - (ii) Outline the procedure for carrying out the Vicker's hardness test on a steel sample. (10 marks)
 - (c) Explain each of the following defects caused by hardness test:
 - (i) pincushion indentation;
 - (ii) barreled indentation. (4 marks)
- 6.
- (a)
 - (i) Define the term powder metallurgy.
 - (ii) State four commercial importance of powder metallurgy technology in the manufacturing industry. (5 marks)
 - (b) Explain three methods of producing metallic powders for powder metallurgy. (6 marks)
 - (c) Describe the conventional steps in the powder metallurgy production process. (9 marks)



7. (a) Define each of the following terms with reference to iron carbon equilibrium diagram:
- (i) phase;
 - (ii) thermal equilibrium diagram;
 - (iii) solidus line;
 - (iv) tie line. (8 marks)
- (b) State **four** uses of the equilibrium diagram in metallurgy. (4 marks)
- (c) Sketch and label the iron-carbon thermal equilibrium diagram. (8 marks)
8. (a) (i) Describe composite materials and state **two** of their advantages over metals. (6 marks)
- (ii) Explain how high strength is achieved in laminar composites. (4 marks)
- (b) Outline **two** functions of each of the constituents of a fibre reinforced polymer matrix composite. (10 marks)
- (c) (i) State **four** properties of ceramics.
- (ii) Explain why ceramics are more brittle than metals.
- (iii) Outline **three** ways in which toughness in ceramics can be improved. (10 marks)

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