NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

Bachelor of Engineering Honours Degree Industrial and Manufacturing Engineering

MANUFACTURING PROCESSES II

EIE 3213

Second Semester Main Examination Paper

March 2025

This examination paper consists of 4 printed pages.

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: None

Examiner's Name: K. N Chinguwo

INSTRUCTIONS AND INFORMATION TO THE CANDIDATE

1. The question paper contains eight (8) questions.
2. Answer any five (5) questions. Only the first five (5) questions attempted will be marked, in the order they appear in the answer booklet
3. Each question carries 20 marks.
4. Ensure neatness and eligibility of work
5. Use of calculators is permissible.

QUESTION 1.

a) Name any three (3) applications of forging. [3]
b) What are the distinct advantages of forging? [5]
c) A cylindrical aluminium workpiece of height 90 mm and diameter 60 mm is subjected to cold upset forging. The aluminium has a flow curve defined by K = 240 MPa and n = 0.15. Assuming a coefficient of friction of 0.1, Determine:
   i. The force as the process begins, [8]
   ii. The force at the final height. [4]

QUESTION 2.

a) What are some of the shortcomings associated with welding as compared to mechanical fastening methods? [10]
b) During weld inspection, what parameters are checked in order to evaluate the weld quality? [10]

QUESTION 3

a) With the aid of diagrams describe Shielded Metal Arc Welding (SMAW) and Gas Metal Arc Welding (GMAW). [8]
b) Describe the effect of strain rate in metal forming? [2]
c) Clearly distinguish between bulk deformation and sheet metal processes. [4]
d) A metal has a flow curve with parameters: strength coefficient = 640 MPa and strain hardening exponent = 0.28. During a forming operation, the final true strain that the metal experiences is 0.85. Determine:
   i. The flow stress at this strain, [3]
   ii. The average flow stress that the metal experienced during the operation. [3]

QUESTION 4.

a) Discuss the evolution of microstructure and material properties during an open die hot forging operation. Use diagrams to support your answer. [6]
b) A cylindrical workpiece is subjected to a cold upset forging operation. The starting piece is 75 mm in height and 50mm in diameter. It is reduced in the operation to a height of 36 mm. The work material has a flow curve defined by K = 350MPa and n = 0.17. Assume a coefficient of friction of 0.1. Determine
   i. The force as the process begins, [8]
   ii. The force at intermediate heights of 49 mm and at the final height of 36 mm. **Comment** on your answers. [6]

QUESTION 5.

a) State and justify the lubricant characteristics that would be suitable for hot metal forming operations. [6]

b) Why is flash desirable in impression-die forging? [2]

c) Why is friction a factor in determining the ram force in direct extrusion but not a factor in indirect extrusion? [4]

d) Why are bulk deformation processes so important commercially? [4]

e) What are some of the challenges associated with tandem rolling? [4]

QUESTION 6.

a) Clearly define the deference between brazing and soldering. What are five advantages do the two have over welding? [5]

b) Using clearly labelled diagrams, show how the process of Explosive Welding is achieved. [10]

c) Name the joints shown on **Figure Q6** [5]

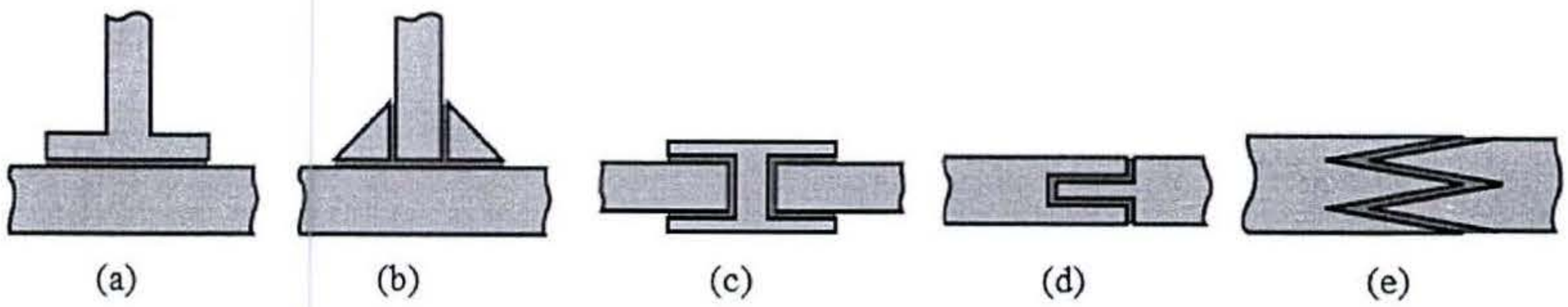

Figure Q6: Different Types of Joints

QUESTION 7.

(a) Why is flash desirable in impression-die forging? [2]

(b) Explain "springback" in sheet metal bending and describe any one method used to compensate for it. Use diagrams to support your answer. [6]

(c) A right-angle bracket has leg lengths of 90 and 50 mm with a 3 mm corner radius and is made from a 2 mm thick sheet. Calculate the length of the blank required to complete this operation. [6]

(d) Briefly describe the incremental sheet forming process, clearly stating typical applications. [6]

QUESTION 8.

(a) Livalo manufacturing company is considering investing in a rolling mill. However, as the engineer in the organisation, management has requested you do the following:

i. Distinguish four (4) configurations of rolling mills (use appropriate diagrams). [12]

ii. Besides rails, name four (4) other products of a rolling mill. [4]

iii. Name the types of rolling illustrated in **Figure Q8 a) and b)** and highlight the areas of application. [4]

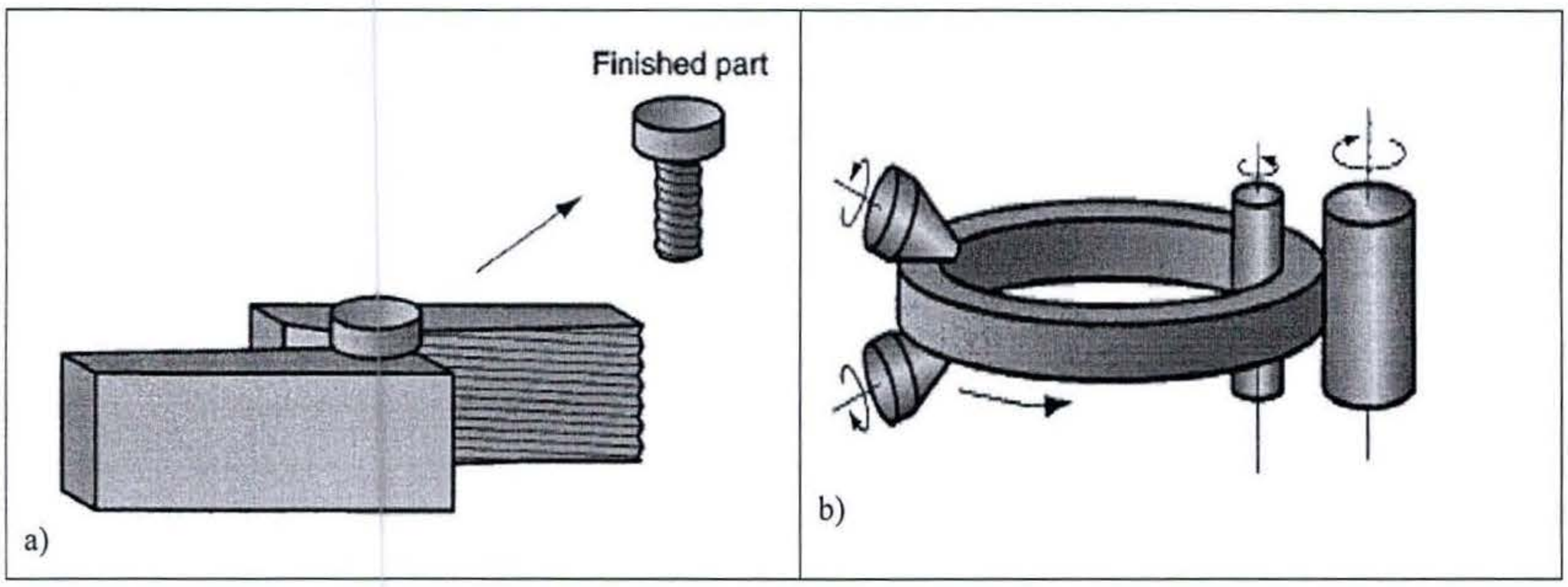

Figure Q8 a) and b) Types of Rolling

THE END!