UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME   :   METAL FORMING TECHNOLOGY

COURSE CODE   :   BNG 32103

PROGRAMME CODE   :   BNG

EXAMINATION DATE   :   JULY 2024

DURATION   :   2 HOURS 30 MINUTES

INSTRUCTIONS   :   1. ANSWER **ALL** QUESTIONS
                         2. THIS FINAL EXAMINATION IS CONDUCTED VIA
                            ☐ Open book
                            ☒ Closed book
                         3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

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Q1   Answer all the following questions;

(a)   A tensile test is carried out to determine the strength constant C and strain-rate sensitivity exponent m for a certain metal at 600 °C. At a strain-rate = 10/s, the stress is measured at 180 MPa; and at a strain rate = 300/s, the stress = 400 MPa.

(i)   Determine C and m.

(8 marks)

(ii)   Describe the expected changes for value C and m if the temperature were 750 °C.

(2 marks)

(b)   Bulk deformation processes are generally characterized by significant deformations and massive shape changes and the surface area-to-volume of the work is relatively small.

(i)   Differentiate in term of processes between extrusion and drawing.

(4 marks)

(ii)   Sketch the diagram for both extrusion and drawing process with label respectively.

(6 marks)

(c)   Metalworking lubricants are applied to the tool-work interface in many forming operations to reduce the harmfull effects of friction. List **FIVE (5)** considerations in choosing an appropriate lubricants of metalworking.

(5 marks)

Q2   (a)   There are other deformations process that related to rolling in the metal rolling operations. Describe **TWO (2)** types of rolling process involved and give **TWO (2)** advantages for each process.

(6 marks)

(b)   A cylindrical workpiece is subjected to a cold upset forging operation. The starting piece is 75 mm in height and 50 mm in diameter. It is reduced in the operation to a height of 30 mm. The work material has a flow curve defined by $K = 360$ MPa and $n = 0.17$. Assume a coefficient of friction is 0.1. Determine;

(i)   The force as the process begins. Assume that, at the start yielding, h is slightly less than 75 mm and true strain is 0.002.

(5 marks)

(ii)   The force at intermediate height of 50 mm.

(9 marks)

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(c)   List **FIVE (5)** principles and limitations that must be considered in the part design or in the selection of forging as the manufacturing process to make the part of forging die terminology.

(5 marks)

Q3   Extrusion is a compression process in which the work metal is forced to flow through a die opening to produce a desired cross-sectional shape.

(a)   Explain the differences between direct and indirect extrusion process with a sketching the diagram.

(8 marks)

(b)   A cylindrical billet that is 100 mm long and 50 mm in diameter is to be extruded in a direct extrusion operation with ratio $r_x = 5.0$. The extrudate has a round cross-section. The die angle is 90°. The work metal has a strength coefficient of 800 MPa, and strain hardening exponent = 0.13. The Johnson equation has, $a = 0.8$ and $b = 1.4$. Determine;

(i)   Average flow stress.

(5 marks)

(ii)   Pressure at a starting billet.

(3 marks)

(iii)   Pressure at the end of billet.

(3 marks)

(c)   Identify the defects in extruded products and sketch for each defect.

(6 marks)

Q4   (a)   Sheet-metal drawing is a more complex operation than cutting or bending, and more things can go wrong. A number of defects can occur in a drawn product. List **FOUR (4)** common defects that can be occur in drawing operations.

(4 marks)

(b)   Bending in sheet-metal work is defined as the straining of the metal around a straight axis where the bending operation, the metal on the inside of the neutral plane is compressed, while the metal on the outside of the plane is stretched. With the aid of sketching diagram, explain **TWO (2)** types of sheet-metal bending operations.

(12 marks)

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(c) A drawing operation is used to form a cylindrical cup with inside diameter of 75 mm and height = 50 mm. The starting blank size = 138 mm and the stock thickness = 24 mm.

(i) Determine the drawing ratio, reduction and thickness-to-diameter ratio.

(5 marks)

(ii) Based on the Answer **Q4 (c) (i)**, justify the operation feasibility.

(4 marks)

- END OF QUESTIONS -

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