UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	METAL FORMING TECHNOLOGY
COURSE CODE	:	BNG 32103
PROGRAMME CODE	:	BNG
EXAMINATION DATE	:	JULY / AUGUST 2023
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	1.	ANSWER **ALL** QUESTIONS
	2.	THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSE 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

Q1 (a) The metal has a flow curve with parameters; strength coefficient = 850 MPa and strain-hardening exponent = 0.30. A tensile specimen of the metal with gage length = 100 mm is stretched to a length = 157 mm. Compute the flow stress at the new length and the average flow stress that the metal has been subjected to during deformation.

(10 marks)

(b) Metal forming includes a large group of manufacturing processes in which plastic deformation is used to change the shape of metal workpieces.

(i) Differentiate between bulk deformation processes and sheet metal processes?

(10 marks)

(ii) Give **TWO (2)** examples for basic bulk deformation and **TWO (2)** examples for sheet metal operations.

(5 marks)

Q2 (a) In metal rolling, there are other deformation process that related to rolling. List **TWO (2)** types of rolling process involved and give **ONE (1)** advantage for each process.

(4 marks)

(b) The process in metal forming can be distiguised into three temperature ranges. Describe **THREE (3)** advantages and **THREE (3)** disadvantages of cold working relative to warm and hot working?

(6 marks)

(c) A 42.0 mm thick plate made of low carbon steel is to reduce to 34.0 mm in one pass in a rolling operation. As the thickness is reduced, the plate widens by 4 %. The yield strength of the steel plate is 174 MPa, and the tensile strength is 290 MPa. The entrance speed of the plate is 15.0 m/min. the roll radius is 325 mm, and the rotational speed is 49.0 rev/min. Given the roll speed equation is $v = \pi r^2 N$. Calculate:

(i) The minimum required coefficient of friction would make this rolling operation possible.

(5 marks)

(ii) The exit velocity of the plate.

(5 marks)

(iii) The forward slip.

(5 marks)

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Q3 (a) 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 36 mm. The work material has a flow curve defined by $\kappa = 350$ MPa and $n = 0.17$. Assume a coefficient of friction of 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 = 0.002.

   (6 marks)

   (ii) The force at intermediate height of 62 mm.

   (6 marks)

   (b) 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.

   (i) Explain the difference between direct and indirect extrusion process.

   (4 marks)

   (ii) Friction is required to determine the ram force in direct extrusion but not a factor in indirect extrusion, explain briefly.

   (4 marks)

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

   (5 marks)

Q4 (a) Wire and bar drawing are bulk deformation process in which the cross-section of wire or bar is reduced by pulling (drawing) it through a die opening.

   (i) Although the workpiece in a wire drawing operation is subjected to tensile stresses, explain how compressive stresses also play a role in the process?

   (5 marks)

   (ii) In a wire drawing operation, describe why the drawing stress must never exceed the yield strength of the work metal?

   (5 marks)

   (b) Bending in sheet-metal work is defined as the straining of the metal around a straight axis where during 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.

   (i) With the aid of sketching diagram, explain **TWO (2)** types of sheet metal bending operations

   (10 marks)

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(ii)   Explain the function of bend allowance intended to compensate.

(5 marks)

-END OF QUESTIONS –