Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	METAL FORMING TECHNOLOGY
COURSE CODE	:	BNM 40703
PROGRAMME CODE	:	BNM
EXAMINATION DATE	:	DECEMBER 2018 / JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWERS **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 **(a)** In metal forming, the processes can be distinguish into three temperature range. List **FIVE (5)** advantages and **THREE (3)** disadvantages of cold working relative to warm and hot working?

(8 marks)

(b) A 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. Identify the flow stress at the new length and the average flow stress that the metal has been subjected to during the deformation.

(12 marks)

Q2 **(a)** Most of rolling processes are very capital intensive, requiring massive pieces of equipment, called rolling mills. Describe the various configurations of rolling process as mention below with an aid of illustration.

(i) Two-high reversing rolling mill.

(4 marks)

(ii) Three-high rolling mill.

(4 marks)

(iii) Tandem rolling mill.

(3 marks)

(b) Drawing is a sheet-metal-forming operation used to make cup-shaped, box-shaped, or other complex-curved and concave parts. It is performed by placing a piece of sheet metal over a die cavity and then pushing the metal into the opening with a punch.

(i) Distinguish in details between redrawing and reverse drawing with an aid of illustrations.

(10 marks)

(ii) Explain **TWO (2)** of the possible defects in drawn sheet metal parts?

(4 marks)

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

(i) Demonstrate with a diagram the different between direct and indirect extrusion process.

(6 marks)

(ii) Explain why is friction in determining the ram force in direct extrusion but not a factor in indirect extrusion?

(4 marks)

(b) A cup is to be drawn in a deep drawing operation. The height of the cup is 75 mm and its inside diameter = 100 mm. The sheet metal thickness = 2 mm. If the blank diameter = 225 mm, made a hypothesis whether the operation seem feasible or not?

(5 marks)

Q4 **(a)** 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) Explain with a diagram each of the two types of sheet metal bending operations.

(6 marks)

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

(2 marks)

(iii) Describe springback in sheet metal bending and show the equation of it.

(3 marks)

(b) A 42.0 mm thick plate made of low carbon steel is to be reduced 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 $v_r = \pi r^2 N$. Calculate:

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

(5 marks)

(ii) Exit velocity of the plate.

(6 marks)

(iii) Forward slip.

(3 marks)

Q5 **(a)** An L shaped part is to be bent in a V bending operation on a press brake from a flat blank 4.0 in by 1.5 in that is 5/32 in thick. The bend of 90° is to be made in the middle of the 4.0 in length. Determine:

(i) The dimensions of the two equal sides that will result after the bend, if the bend radius = 3/16 in.

(6 marks)

(ii) The bending force required if the bend is to be performed in a V-die with a die opening width dimension = 1.25 in. The material has a tensile strength = 70,000 lb/in^2.

(4 marks)

(b) A billet 75 mm long and 25 mm in diameter is to be extrude in a direct extrusion operation with extrusion ratio $r_x = 4.0$. The extrude has a round cross section. The die angle (half angle) = 90°. The work metal has a strength coefficient = 415 MPa, and strain-hardening exponent = 0.18. Use the Johnson formula with $a = 0.8$ and $b = 1.5$ to estimate extrusion strain. Evaluates the pressure applied at the start and to the end of the billet.

(5 marks)

-END OF QUESTIONS-