NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

Faculty of Industrial Technology

Department of Industrial and Manufacturing Engineering

BEng. Degree in Industrial and Manufacturing Engineering

MANUFACTURING PROCESSES II - TIE 3213

2nd Semester Examination

August 2009

Instructions to Candidates

1. Examination length is **3hrs**.
2. Each question carries twenty **(20)** marks and there are six **(6)** questions in total.
3. Attempt the whole of Section A and three questions from Section B.

Section A

Question 1

a) What is the difference between deep drawing and wire drawing? [4]

b) Draw a schematic illustration of a deep drawing operation with a circular punch, indicating the die radius, punch diameter, and punch corner radius. [6]

c) A cooking pot of 300 mm outside diameter, 200 mm depth, 3 mm wall thickness, and 5 mm bottom thickness is to be made from an aluminium alloy by deep drawing. The UTS of the alloy is 190MPa. Determine

(i) The punch diameter [2]

(ii) Starting blank diameter [3]

(iii) The maximum drawing force [3]

d) Hold-down pressure is a significant parameter in deep drawing operations. Explain the likely outcome if

(i) Hold-down pressure is zero [1]

(ii) Hold-down pressure is excessive [1]

Question 2

a) Discuss the design aspects that have to be considered in impression die forging. [7]

b) In preparation of forging a large gear blank, a high carbon steel billet of 200 mm diameter and 500 mm height is upset at 1000^{o}C to a 100 mm thick flat disk. A graphite lubricant is used and lowers friction to μ=0.2. Strength coefficient C = 120 MPa and strain rate sensitivity exponent m = 0.13. A hydraulic press with a speed of 4m/min is used. The frictional shear factor is twice the coefficient of friction.

(i) Make a sketch of the operation. [3]

(ii) Calculate the average die pressure. [8]

(iii) Determine the forging force. [2]

Section B

Question 3

a) Describe the roll pass sequence used in rolling of metals. [6]

b) A 100-mm-wide, 2-mm-thick strip is flat rolled to a gauge thickness of 0.7 mm. Measurements reveal that the strip width has increased to 110 mm. What is the strain in the rolling direction? [6]

c) A phosphor bronze strip of w = 20 mm and h = 15mm is cold-rolled to 20% of its original height in a single pass, on a mill with 150 mm diameter rolls, at v = 0.8m/s, with a mineral oil lubricant ($\mu = 0.07$). Strength coefficient K is 720 MPa and strain hardening exponent n is 0.46.

(i) Calculate the roll force. [6]

(ii) What is the power requirement? [2]

Question 4

a) Compare the properties of components produced by cold and hot metal extrusion. [6]

b) Commercial purity aluminium billets of 300 mm diameter are extruded at 500°C, with a ram speed of 0.6m/min, into 150-mm-diameter bars. Assuming a dead-metal zone of 45° and ignoring friction, determine

(i) Basic extrusion pressure [8]

(ii) Extrusion force [3]

(iii) Speed at which the extrusions emerge. [3]

Question 5

a) Explain the following defects found in sheet metal products and suggest ways they can be corrected or avoided.

(i) Earing [3]

(ii) Lüders lines [3]

(iii) Orange peel [3]

b) Show that in bending, the bend radius ratio R_b is related to the engineering strain e at the ultimate tensile strength by the expression

$$\frac{Rb}{t} = 0.5(e^{-u} - 1)$$ [6]

c) A metal is yielding plastically under a stress state of σ_x = -40 MPa, σ_y = 50 MPa, and σ_z = 20 MPa. Determine the flow stress using

(i) Tresca criterion [2]

(ii) von Mises criterion [3]

Question 6

a) What factors necessitate the use of joining processes in manufacturing? [4]

b) Demonstrate an understanding of solid state welding by describing in detail one solid state welding process. [6]

c) Make a sketch of a weld joint showing the different zones. [4]

d) Briefly describe Resistance Spot Welding (RSW). [6]

End of Examination