UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACHELOR OF ENGINEERING TECHNOLOGY: MECHANICAL
SUBJECT	:	MECHANICAL MANUFACTURING AND WORKSHOP PRACTICE 2A (WKSMIA2) WINTER SAA EXAMINATION
DATE	:	JUNE 2018
DURATION	:	3 hours
TOTAL MARKS	:	120 120 Marks = 100%

ASSESSOR	:	MR MD MUKHAWANA
MODERATOR	:	FK TEKWEME
NUMBER OF PAGES	:	6 PAGES (INCLUDING FORMULA SHEET)

REQUIREMENTS	:	DRAWING INSTRUMENTS TO BE SUPPLIED BY STUDENTS.

INSTRUCTIONS TO STUDENTS

1. READ THE QUESTIONS CAREFULLY.
2. ANSWER ALL THE QUESTIONS
3. SHOW ALL CALCULATIONS
4. NUMBER YOUR ANSWERS STRICTLY ACCORDING TO THE QUESTIONS.
5. ALL ANSWERS, BOTH INTERMEDIATE AND FINAL, MUST HAVE THE CORRECT UNITS
6. 120 MARKS = 100 PERCENT.
7. ALL SKETCHES ARE TO BE DRAWN IN PENCIL AND TO GOOD PROPORTION.
8. UNTIDY WORK WILL BE PENALISED.
9. GRAVITATIONAL ACCELERATION = 9.81 m/s^2

QUESTION 1

1.1 Discuss five limitations and disadvantages of casting. (5)

1.2 Describe five desirable mold properties during sand casting (5)

1.3 Discuss five Steps to follow in Sand Casting (5)

1.4 A sufficient amount of pure copper is to be heated for casting a large plate in an open mold. The plate has dimensions: length = 25 cm, width = 50 cm, and thickness = 7.5 cm. Calculate the amount of heat that must be added to the metal to heat it to a temperature of 1175°C for pouring. Assume that the amount of metal heated will be 10% more than what is needed to fill the mold cavity. Properties of the metal are: density = 0.009 kg/cm3, melting point = 1083°C, specific heat of the metal = 0.395/g°C in the solid state and 0.38 J/g°C in the liquid state, and heat of fusion = 186 kJ/Kg. Assuming room temperature = 24 ° C. (7)

1.5 In the casting of steel under certain mold conditions, the mold constant in Chvorinov's rule is known to be 4.0 min/cm2, based on previous experience. The casting is a flat plate whose length = 30 cm, width = 10 cm, and thickness = 20 mm. Determine how long it will take for the casting to solidify. (6)

[28]

QUESTION 2

2.1 Discuss five disadvantages of arc welding (5)

2.2 Define fusion welding and Solid-State welding (2)

2.3 Name and sketch the five joint types (10)

2.4 A heat source can transfer 3500 J/sec to a metal part surface. The heated area is circular, and the heat intensity decreases as the radius increases, as follows: 70% of the heat is concentrated in a circular area that is 3.75 mm in diameter. (4)

2.5 A welding operation on an aluminum alloy makes a groove weld. The cross-sectional area of the weld is 30.0 mm2. The welding velocity is 4.0 mm/sec. The heat transfer factor is 0.92 and the melting factor is 0.48. The melting temperature of the aluminum alloy is 650°C. Determine the rate of heat generation required at the welding source to accomplish this weld. (4)

[25]

QUESTION 3

3.1 A 11.2 cm-thick slab that is 22.5 cm wide and 60 cm long is to be reduced in a single pass in a two-high rolling mill to a thickness of 9.6 cm. The roll rotates at a speed of 5.50 rev/min and has a radius of 42.5 cm. The work material has a strength coefficient = 205 MPa and a strain hardening exponent = 0.15. Determine:

a) the reduction (2)

b) he true strain (2)

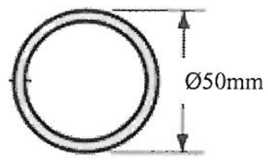
c) the average flow stress (2)

d) the roll force (4)

e) the roll torque (2)

f) the power required to accomplish this operation. (3)

3.2 In a direct extrusion operation the cross section shown on the right is produced from a copper billet whose diameter = 0.1 m and length = 0.5 m. In the flow curve for copper, the strength coefficient = 300 MPa and strain hardening exponent = 0.50. In the Johnson strain equation, $a = 0.8$ and $b = 1.5$. Determine:



Thickness = 2.5mm

a) the extrusion ratio, and (3)

b) the shape factor, (4)

[22]

QUESTION 4

4.1 Describe the following terms during sheet metal working process:

a) cutting, (1)

b) bending, and (1)

c) drawing. (1)

4.2 What is the difference between blanking and punching during sheet metal working process? (2)

4.3 Describe each of the two types of sheet-metal-bending operations: V-bending and edge bending. (2)

4.4 A compound die will be used to blank and punch a large washer out of 6061ST aluminum alloy sheet stock 3.50 mm thick. The outside diameter of the washer is 50.0 mm and the inside diameter is 15.0 mm. Determine

a) the punch and die sizes for the blanking operation, (5)

b) the punch and die sizes for the punching operation, and (3)

c) the blanking force required if the shear strength of the steel = 325 MPa and the tensile strength is 450 MPa. (4)

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QUESTION 5

5.1 What are the three basic steps in the conventional powder metallurgy shaping process? (3)

5.2 What is the technical difference between mixing and blending in powder metallurgy? (2)

5.3 Discuss six reasons why powder metallurgy technology is important. (6)

5.4 Describe the word "Mesh count" (1)

[12]

QUESTION 6

6.1 How does a boring operation differ from a turning operation? (2)

6.2 What is a different between Generating and forming? (2)

6.3 Name the five ways in which a workpart can be held in a lathe. (5)

6.4 What is the difference between threading and tapping? (2)

6.5 In a production turning operation, the foreman has decreed that a single pass must be completed on the cylindrical workpiece in 5.0 min. The piece is 400 mm long and 150 mm in diameter. Using a feed = 0.30 mm/rev and a depth of cut = 4.0 mm, what cutting speed must be used to meet this machining time requirement? (3)

[14]

TOTAL = 120 Marks

Useful Information

$H = \rho V\{C_s(T_m - T_o) + H_f + C_l(T_p - T_m)\}$ $\quad T_{TS} = C_m\left(\frac{V}{A}\right)^n$ $\quad v = \sqrt{2gh}$ $\quad T_{MF} = \frac{V}{Q}$ $\quad Q = v_1 A_1 = v_2 A_2$

$g = 9.81\frac{m}{s^2} = 981\frac{cm}{s^2}$ $\quad K = 3.33 \times 10^{-6}$ $\quad H_w = f_1 f_2 H$ $\quad U_m = K T_m^2$ $\quad H_w = U_m V$

$R_{Hw} = U_m R_{WV}$ $\quad R_{Hw} = f_1 f_2 R_H = U_m A_w v$

$d = t_o - t_f$ $\quad d_{max} = \mu^2 R$ $\quad r = \frac{d}{t_o}$ $\quad s = \frac{v_f - v_r}{v_r}$ $\quad v_r = \pi R^2 N$ $\quad \epsilon = \ln\frac{t_o}{t_f}$

$t_o w_o v_o = t_f w_f v_f$ $\quad t_o w_o L_o = t_f w_f L_f$ $\quad \overline{Y}_f = \frac{K\epsilon^n}{1+n}$ $\quad F = \overline{Y}_f w L$ $\quad L = \sqrt{R(t_o - t_f)}$

$T = 0.5\,FL$ $\quad P = 2\pi NFL$

$V = Ah$ $\quad V = \frac{\pi D^2 h}{4}$ $\quad \epsilon = \ln\frac{h_o}{h}$ $\quad K_f = 1 + \frac{0.4\,\mu D}{h}$ $\quad Y_f = K\epsilon^n$ $\quad F = K_f Y_f A$

$r_x = \frac{A_o}{A_f}$ $\quad \epsilon = \ln r_x = \ln\frac{A_o}{A_f}$ $\quad \overline{Y}_f = \frac{K\epsilon^n}{1+n}$ $\quad \epsilon_x = a + b\ln r_x$ $\quad p = \overline{Y}_f \epsilon_x$

$P = Fv$ $\quad F = pA_o$ $\quad p = \overline{Y}_f\left(\epsilon_x + \frac{2L}{D_o}\right)$ $\quad K_x = 0.98 + 0.02\left(\frac{C_x}{C_c}\right)^{2.25}$ $\quad p = K_x \overline{Y}_f\left(\epsilon_x + \frac{2L}{D_o}\right)$

$c = A_c t$ $\quad SB = \frac{\alpha' - \alpha'_t}{\alpha'_t}$ $\quad F = StL$ $\quad A_b = 2\pi\frac{\alpha}{360}(R + K_{ba}t)$

Blanking die diameter $= D_b$ $\quad$ Hole punch diameter $= D_h$

Hole die diameter $= D_h + 2c$ $\quad$ Blanking punch diameter $= D_b - 2c$

TABLE 20.1 Clearance allowance value for three sheet-metal groups.

Metal Group	A_c
1100S and 5052S aluminum alloys, all tempers	0.045
2024ST and 6061ST aluminum alloys; brass, all tempers; soft cold-rolled steel, soft stainless steel	0.060
Cold-rolled steel, half hard; stainless steel, half-hard and full-hard	0.075

$N = \frac{v}{\pi D_o}$ $\quad D_f = D_o - 2d$ $\quad f_r = Nf$ $\quad T_m = \frac{L}{f_r}$ $\quad T_m = \frac{\pi D_o L}{fv}$