UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACHELOR OF ENGINEERING TECHNOLOGY: MECHANICAL
SUBJECT	:	MECHANICAL MANUFACTURING AND WORKSHOP PRACTICE 2A (WKSMIA2)
		WINTER EXAMINATION 2018
DATE	:	05 JUNE 2018
DURATION	:	3 hours
TOTAL MARKS	:	121 120 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) Briefly describe the following terms

a) Expendable mold processes (1)

b) Permanent Mold process (1)

1.2) Explain three factors that determine success of pouring the molten metal during casting (3)

1.3) Define the total solidification time in casting. (2)

1.4) A casting experiment performed using a certain alloy and type of sand mould, it took 155 seconds for a rectangular-shaped casting to solidify. The rectangular shape with dimensions: is L =69 mm, B = 66 mm and H = 10 mm.

a) Determine the value of the mould constant in Chvorinov's rule, and (5)

b) If the same alloy and mould type were used, calculate the total solidification time for a cylindrical casting in which the diameter = 30 mm and length = 50 mm. (7)

1.5) A mold has a downsprue of length = 0.15 m. The cross-sectional area at the bottom of the sprue is 0.0003125 m^2. The sprue leads into a horizontal runner which feeds the mold cavity, whose volume = 0.001172 m^3. Determine:

a) the velocity of the molten metal flowing through the base of the downsprue, (2)

b) the volume rate of flow, and the time required to fill the mold cavity. (4)

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QUESTION 2

2.1) Discuss five factors that may be considered when choosing a welding process. (5)

2.2) Discuss any five safety recommendations pertaining usage of gas welding (5)

2.3) What is the function of the each of following gas welding equipment?

a) Gas pressure regulators (1)
b) Goggles (1)
c) Gloves (1)
d) Spark-lighter (1)
e) Welding torch (1)

2.4) A heat source transfers 3000W to the surface of a metal part. The heat impinges the surface in a circular area, with intensities varying inside the circle. The distribution is as follows: 70% of the power is transferred within a circle of diameter = 5mm, and 90% is transferred within a concentric circle of diameter = 12 mm. What are the power densities in

(a) The 5-mm diameter inner circle and (3)

(b) The 12-mm-diameter ring that lies around the inner circle? (3)

2.5) The welding power generated in a particular arc-welding operation = 3000 W. This is transferred to the work surface with a heat transfer factor = 0.9. The metal to be welded is copper whose melting point is 1350°K. Assume that the melting factor = 0.25. A continuous fillet weld is to be made with a cross-sectional area = 15.0 mm^2. Determine the travel speed at which the welding operation can be accomplished. (5)

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QUESTION 3

3.1 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. Determine

a) The minimum required coefficient of friction that would make this rolling operation possible, (3)

b) The exit velocity of the plate, and (3)

c) The forward slip (4)

3.2 A plate that is 250 mm wide and 25 mm thick is to be reduced in a single pass in a two-high rolling mill to a thickness of 20 mm. The roll has a radius = 500 mm, and its speed = 30 m/min. The work material has a strength coefficient = 240 MPa and a strain hardening exponent = 0.2. Determine :

a) the draft (2)

b) reduction (2)

c) true strain (2)

d) average flow stress (2)

e) roll force (4)

f) roll torque (2)

g) power required to accomplish this operation. (3)

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QUESTION 4

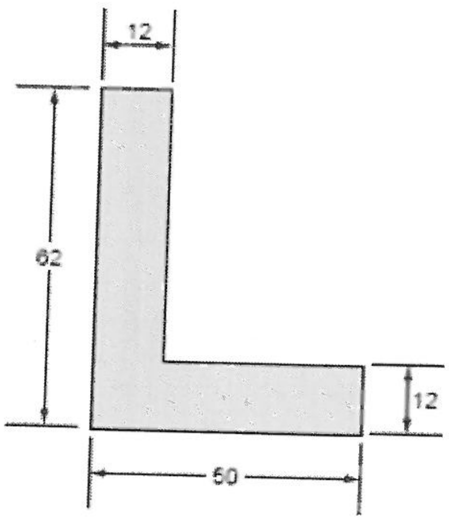
4.1) Discuss five advantages of using of sheet metal process (5)

4.2) Give three basic types of sheet metal processes (3)

4.3) Explain three advantages of Guerin Process (3)

4.4) A blanking operation is to be performed on 1.2 mm thick cold-rolled steel (half hard). The part is circular with diameter = 75.0 mm. $A_c = 0.075$. Determine the appropriate punch and die sizes for this operation. (5)

4.5) A blanking die is to be designed to blank the 4 mm thick stainless steel part outline shown below. Determine the tonnage requirements for blanking operation given that stainless steel has a yield strength of 500 MPa, a shear strength of 600 MPa and a tensile strength of 700 MPa. (4)



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QUESTION 5

5.1) Discuss three disadvantages of powder metallurgy methods. (3)

5.2) What is the difference between open pores and closed pores in a metallic powders? (2)

5.3) Define bulk density and true density for metallic powders (2)

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

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QUESTION 6

6.1 What are the differences between rotational parts and prismatic parts in machining? (2)

6.2 Describe the turning process. (1)

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

6.4 A cylindrical workpart 200 mm in diameter and 700 mm long is to be turned in an engine lathe. Cutting speed = 2.30 m/s, feed = 0.32 mm/rev, and depth of cut = 1.80 mm. Determine

(a) Cutting time, and (6)

(b) Metal removal rate. (2)

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TOTAL = 121 Marks

Useful Information

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

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

$R_{Hw} = U_m R_{WV}$ $R_{Hw} = f_1 f_2 R_H = U_m A_w V$

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

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

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

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

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

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

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

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

Hole die diameter $= D_h + 2c$ 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

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