



<u>PROGRAM</u>	: NATIONAL DIPLOMA <i>ENGINEERING : MECHANICAL</i> <i>ENGINEERING : INDUSTRIAL</i>
<u>SUBJECT</u>	: MECHANICAL MANUFACTURING ENGINEERING II
<u>CODE</u>	: IMV2211 SUMMER EXAMINATION
<u>DATE</u>	: 05 DECEMBER 2016
<u>TIME:</u>	: 12H30 – 15H30
<u>DURATION</u>	: 3 hours
<u>TOTAL MARKS</u>	: 120 120 Marks = 100%
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<u>ASSESSOR</u>	: MR MD MUKHAWANA
<u>MODERATOR</u>	: MR C RAK
<u>NUMBER OF PAGES</u>	: 5 PAGES (INCLUDING FORMULAR SHEET)
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<u>REQUIREMENTS</u>	: 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
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QUESTION 1

- 1.1 Give three factors that determine success of pouring the molten metal during casting (3)
- 1.2 Briefly describe the following terms (2)
- a) Expendable mold processes
 - b) Permanent Mold process
- 1.3 Define the total solidification time in casting. (2)
- 1.4 Give three materials can be used to make Pattern during casting (3)
- 1.5 Give five advantages of using permanent mold process (5)
- 1.6 What is the deference between thermoplastics and thermoset plastics (2)
- 1.7 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 $L = 69 \text{ mm}$, $B = 66 \text{ mm}$ and $H = 10 \text{ mm}$.
- a) Determine the value of the mould constant in Chvorinov's rule. (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)
- 1.8 A Volume of 2575 cm^3 of a eutectic alloy is heated from room temperature (25°) to a pouring temperature of 850° , melting temperature is 700° . The alloy's density is 8 g/cm^3 , specific heat in solid state is $0.84 \text{ J/g}^\circ\text{C}$ and specific heat for a liquid state is $0.74 \text{ J/g}^\circ\text{C}$ and the heat of fusion is 125 J/g . How much heat must be added to get metal to pouring heat, assuming no losses? (5)

[34]**QUESTION 2**

- 2.1 Give five factors that may be considered when choosing a welding process. (5)
- 2.2 Give three basic types of oxy-acetylene flames during oxy-acetylene welding (3)
- 2.3 Give any five safety recommendations pertaining usage of gas welding (5)
- 2.4 What are function of the following gas welding equipment? (5)
- a) Gas pressure regulators
 - b) Goggles
 - c) Gloves
 - d) Spark-lighter
 - e) Welding torch

- 2.5 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)
- 2.6 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 for copper. Assume that the melting factor = 0.25. A continuous fillet weld is to be made with a cross-sectional area = 15.0 mm². Determine the travel speed at which the welding operation can be accomplished. (5)

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QUESTION 3

- 3.1 A 0.112 m-thick slab that is 0.225 m wide and 0.6 m long is to be reduced in a single pass in a two-high rolling mill to a thickness of 0.096 m. The roll rotates at a speed of 5.50 rev/min and has a radius of 0.425 m. The work material has a strength coefficient = 205 MPa and a strain hardening exponent = 0.15. 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)
- 3.2 A 7.5 cm-long cylindrical billet whose diameter = 3.75 cm is reduced by indirect extrusion to a diameter = 0.9 cm. Die angle = 90°. In the Johnson equation, $a = 0.8$ and $b = 1.5$. In the flow curve for the work metal, $K = 520$ MPa and $n = 0.25$
- a) extrusion ratio, (3)
 - b) true strain (homogeneous deformation), (3)
 - c) extrusion strain, (2)
 - d) Ram pressure, and (4)
 - e) Ram force. (3)
 - f) Power if the ram speed = 50 cm/min. (2)

QUESTION 4

- 4.1 Give five advantages of using of Sheet Metal process (5)
- 4.2 Give three Basic Types of Sheet Metal Processes (3)
- 4.3 A blanking operation is to be performed on 2.0 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. (4)

[12]

QUESTION 5

- 5.1 Give four disadvantages of powder metallurgy methods. (4)
- 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)

[11]

TOTAL = 120 Marks

Useful Information

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

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

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

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

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

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

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

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

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

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

$$\text{Blanking die diameter} = D_b$$

$$\text{Hole punch diameter} = D_h$$

$$\text{Hole die diameter} = D_h + 2c$$

$$\text{Blanking punch diameter} = D_b - 2c$$

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