SULIT

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

PEPERIKSAAN AKHIR
SEMESTER II
SESI 2010/2011

NAMA KURSUS	:	REKABENTUK UNTUK PEMBUATAN DAN PEMASANGAN
KOD KURSUS	:	BDD 4013
PROGRAM	:	SARJANA MUDA KEJURUTERAAN MEKANIKAL DENGAN KEPUJIAN
TARIKH PEPERIKSAAN	:	APRIL / MEI 2011
JANGKA MASA	:	2 JAM 30 MINIT
ARAHAN	:	JAWAB **EMPAT** SOALAN SAHAJA DARI LIMA SOALAN YANG DISEDIAKAN.

KERTAS SOALAN INI MENGANDUNGI LAPAN (8) MUKA SURAT

SULIT

Q1 (a) FOUR (4) basic approaches in implementing Design for Assembly (DFA) have been identified. List and describe in detail the important characteristics of all the approach.

(6 marks)

(b) Among the general guidelines of Design for Assembly are "aim for simplicity" and "design for process". Describe in detail the meaning of both guidelines.

(6 marks)

(c) Boothroyd and Dewhurst have addressed THREE (3) main problems in the process of assembly a product. Explain all the problems.

(6 marks)

(d) Explain the differences between curved and conical chamfers in terms of insertion time and manufacturing cost. Estimate the manual insertion time for a plain cylindrical peg if the hole diameter is 25 mm, the peg diameter is 24.5 mm, the depth of insertion is 60 mm when the chamfer is on the peg (f = -250)?

(7 marks)

Q2 (a) Determine at least SEVEN (7) violations against the DFMA guidelines and rules on the features of the design.

(7 marks)

(b) Using **Table 1** determine the possible manufacturing processes that can be used to produce the components below (**Figure Q2** (i-iii)). List the shape features of each component in your answer.

(12 marks)

(c) If the material for component (i) is cast iron, for component (ii) is polyamide 6 and for component (iii) is stainless steel determine the process that would be compatible.

(6 marks)

Q3 (a) Explain briefly SIX (6) of the design guidelines in machining operation.

(6 marks)

(b) Explain how these key cost drivers influence the recurring costs in a CNC lathe machining process.

(i) Surface finish
(ii) Tolerance
(iii) Material Type

(9 marks)

(c) **Figure Q3** shows a sectioned view of a step shaft which is to be produced using a lathe machine. With respect to the design for turning operation, identify and explain the features/profile that incurs high cost. Suggest a new profile with appropriate drawing of the shaft that can reduce the machining cost.

(10 marks)

Q4 (a) What are the two (2) fundamental ways in which parts can be made from sheet metals?

(5 marks)

(b) With some sketching, differentiate between the following three method of shearing the external profile of a part;

(i) cut-off

(ii) part-off

(iii) blanking

(6 marks)

(c) **Figure Q4** shows the rectangular shape of sheet metal with size 150 mm x 90 mm that surround with nine holes. The perimeter of each non-standard shape for hole "T" and hole "C" is 80 mm and 96 mm respectively. Assume that 50 mm space was allowed at surrounding area of part at the die set. The die manufacture rate is RM35 per hour. Determine the cost of piercing die for drilling these nine holes?

(14 marks)

Q5 (a) A batch of disc with diameter of 20mm and the thickness of 40mm will be printed from ABS material in six cavity mold and sort in order of 3 x 2. The location of this disc in printed moment is shown in **Figure Q5**. Estimate the percentage of runner system increased as 50 percent and the allowance value is 7.5 cm. By using **Table 1** and **Table 2** ,

(i) Determine the appropriate machine sizes.

(6 marks)

(ii) Determine the cycle time

(5 marks)

(iii) Determine the basic molding cost

(4 marks)

(b) Identify the compatibility of the materials against the various processes by redrawing **Table Q5** and filling-up the answer. Classify the compatibility according to weather not applicable, normal practice or less common.

(10 marks)

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Table 2 – Injection Molding Machine

Clamping force (kN)	Shot size (cc)	Operating cost ($/h)	Dry cycle times (s)	Maximum clamp stroke (cm)	Driving power (kW)
300	34	28	1.7	20	5.5
500	85	30	1.9	23	7.5
800	201	33	3.3	32	18.5
1100	286	36	3.9	37	22.0
1600	286	41	3.6	42	22.0
5000	2290	74	6.1	70	63.0
8500	3636	108	8.6	85	90.0

Table 3 – The Processes Data for Selected Polymer

Thermoplastic	Specific gravity	Thermal diffusivity (mm^2/s)	Injection temp. (°C)	Mold temp. (°C)	Ejection temp. (°C)	Injection pressure (bars)
High-density polyethylene	0.95	0.11	232	27	52	965
High-impact polystyrene	1.59	0.09	218	27	77	965
Acrylonitrile-butadiene-styrene (ABS)	1.05	0.13	260	54	82	1000
Acetal (homopolymer)	1.42	0.09	216	93	129	1172
Polyamide (6/6 nylon)	1.13	0.10	291	91	129	1103
Polycarbonate	1.20	0.13	302	91	127	1172
Polycarbonate (30% glass)	1.43	0.13	329	102	141	1310
Modified polyphenylene oxide (PPO)	1.06	0.12	232	82	102	1034
Modified PPO (30% glass)	1.27	0.14	232	91	121	1034
Polypropylene (40% talc)	1.22	0.08	218	38	88	965
Polyester teraphthalate (30% glass)	1.56	0.17	293	104	143	1172

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List of Formula;

$$EM = \frac{3 \times NM}{TM}$$

$$C_{ds} = 120 + 0.36A_u$$

$$t_m = \frac{d_m}{2fn_w}$$

$$X_p = \frac{P^2}{LW}$$

$$v_{\max} = \pi n_w d_m$$

$$M_p = M_{po} f_{lw} f_d$$

$$Z_{w_{\max}} = \pi f a_p n_w d_m$$

$$\text{Total Die Cost} = C_{ds} + \left(M_{po} + M_{pc} + M_{ps}\right)R$$

F (kN) = A (m^2) x P_{max} (kN/m^2)

$$M_{po} = 23 + 0.03LW$$

t = -70 ln (c) –f (chamfer) + 3.7 L + 0.75 d

$$t_f = \frac{V}{Q_{av}} = \frac{2V_s p_j}{P_j}$$

$$M_{pc} = 8 + 0.6P + 3N_p$$

$$t_c = \frac{h^2{}_{\max}}{\pi^2 \alpha} \log_e \frac{4(T_i - T_m)}{\pi(T_x - T_m)}$$

$$M_{ps} = KN_p + 0.4N_d$$

$$t_{close} = 0.5t_d \left[\frac{2D+5}{L_s}\right]^{1/2}$$

$$t_r = 1 + 1.75t_d \left[\frac{2D+5}{L_s}\right]^{1/2}$$

$$t_f = \frac{V}{Q_{av}} = \frac{2V_s p_j}{P_j}$$

$$C_b = 1000 + 0.45A_c h_p{}^{0.4}$$

$$t_{close} = 0.5t_d \left[\frac{2D+5}{L_s}\right]^{1/2}$$

$$n = \left(\frac{N_t k_1 t}{(mC_{c1})}\right)^{1/(m+1)}$$

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TABLE 1 : Shape Generation Capabilities of Processes

	Depress		UniWall	UniSect	AxisRot	RegXSec	CaptCav	Enclosed	NoDraft	PConsol	Alignmt	IntFast	
Sand casting	Y	Y	Y	Y	Y	Y	Y	N	N	4	3	1	Solidification processes
Investment casting	Y	Y	Y	Y	Y	Y	Y	N	N	5	5	2	
Die casting	Y	Y[a]	Y	Y	Y	Y	N	N	N	4	5	3	
Injection molding	Y	Y[a]	Y	Y	Y	Y	N[b]	N	N	5	5	5	
Structural foam	Y	Y[a]	Y	Y	Y	Y	N	N	N	4	4	3	
Blow molding (extr)	Y	Y[a]	M	N	Y	Y	M	Y	N	3	4	3	
Blow molding (inj)	Y	Y[a]	M	N	Y	Y	M	N	N	3	4	3	
Rotational molding	Y	Y[a]	M	N	Y	Y	N	M	N	2	2	1	
Impact extrusion	Y	N	Y	N	Y	Y	N	N	Y	3	3	1	Bulk deformation processes
Cold heading	Y	N	Y	N	Y	Y	N	N	Y	3	3	1	
Closed die forging	Y	Y[a]	Y	Y	Y	Y	N	N	N	3	2	1	
Power metal parts	Y	N	Y	Y	Y	Y	N	N	Y	3	3	1	
Hot extrusion	Y[d]	N	Y	M	Y	Y	N	N	Y	2	2	3	
Rotary swaging	N[c]	N	N	N	M	N[c]	N	N	N	1	1	1	
Machining (from stock)	Y	Y	Y	Y	Y	Y	Y	N	Y	2	3	2	Material removal processes
ECM	Y	Y[c]	Y	Y	Y	Y	N	N	N	3	4	1	
EDM	Y	Y[c]	Y	Y	Y	Y	N	N	N	3	4	1	
Wire-EDM	Y[d]	N	Y	Y	Y	Y	N	N	Y	2	2	3	Profile generating processes
Sheetmetal stamp/bend	Y	Y	M	Y	Y	Y	N	N	N	4	3	4	Sheet forming processes
Thermoforming	Y	Y[a]	M	N	Y	Y	N	N	N	3	3	3	
Metal spinning	N	N	M	N	M	N	Y	N	N	1	1	1	

[a] Possible at higher cost.
[b] Shallow undercuts are possible without significant cost penalty.
[c] Possible with more specialized machine and tooling.
[d] Only continuous, open-ended possible.
Y, Process is capable of producing parts with this characteristic, N, Process is not capable of producing parts with this characteristic. M, Parts produced with this process must have this characteristic. An underlined entry indicates that parts using this process are easier to form with this characteristic.
The last three columns refer to DFA guidelines and are rates on a scale of 1 to 5, with 5 assigned to processes most capable of incorporating the respective guideline.

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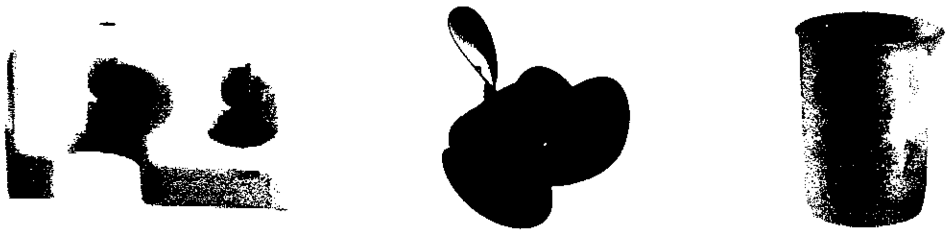

(i) (ii) (iii)

FIGURE Q2

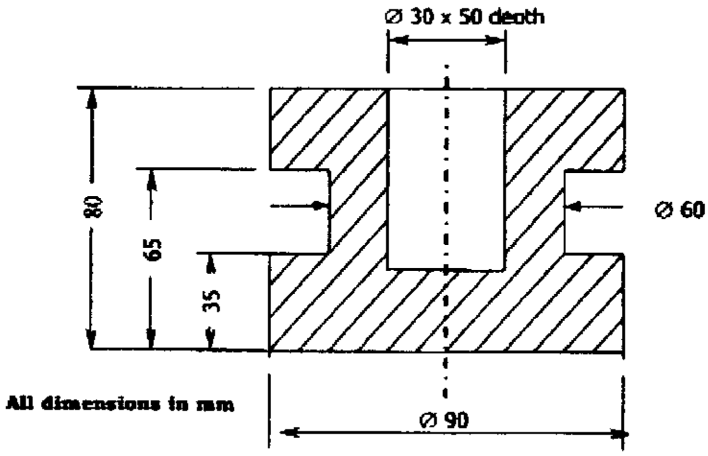

FIGURE Q3

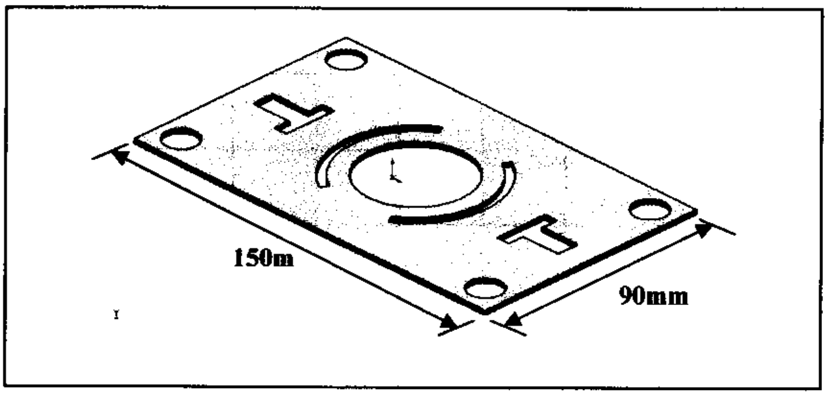

FIGURE Q4