Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	DESIGN FOR MANUFACTURE AND ASSEMBLY
COURSE CODE	:	BDD 40103
PROGRAMME	:	4 BDD
EXAMINATION DATE	:	DEC 2018 / JAN 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER ANY **FIVE (5)** QUESTIONS **ONLY** FROM SIX (6) QUESTIONS

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) There are eight (8) major steps in the new product development process in order the companies to stay successful and be competitive in the current market. The new product development process starts with 'Idea Generation'. Please discuss the roles of Idea Generation in new product development process.

(10 marks)

(b) List and justify **FIVE (5)** characteristics of successful product development

(10 marks)

Q2 (a) By referring **Figure Q2(a)**, please justify the possibility of improvement in the design for machining on mechanical shaft fabrication in the aspects of DFMA roles.

(8 marks)

(b) Due to the application of high cutting speed, please justify with **FOUR (4)** reasons why total production cost increased after 600 FPM (feed per minute), as tolerance and surface finish becomes increasingly fine. Refer **Figure Q2(b)** as reference.

(12 marks)

Q3 (a) Determine the total operation time, total operation cost, and design efficiency for assembly shown in **Figure Q3(a)**. Assume the labor rate is RM 14.40 per hour. Refer to **Table Q3(a1)** and **Table Q3(a2)** as references.

(15 marks)

(b) Please justify why DFA tool is needed as a systematic analysis in any product assembly.

(5 marks)

Q4 (a) The Boothroyd Dewhurst method provides a solution for Design for Assembly (DFA) developed in late 1970s by Professor Geoffrey Boothroyd, at the University of Massachusetts, Amherst in cooperation with Salford University of England. With the help of sketch, please justify the principles and procedures involved in the DFA process.

(12 marks)

(b) List and justify **TWO (2)** achievements when we could apply DFA particularly in early stage product manufacturing.

(8 marks)

Q5 (a) Injection molding is the most commonly used manufacturing process but due to its intricacies product designers need to make adequate design considerations to ensure that part designs focus on maximizing molding performance and reducing tooling costs an area that often plague the injection molding industry. One of the DFMA part design considerations is about 'Radius'. By referring **Figure Q5** give the reasons and justify why 'Radius' is important.

(14 marks)

(b) With the help of sketch, please explain the working principle of Injection Molding.

(6 marks)

Q6 (a) DFMA provides design guidelines for sheet metal designer which helps to develop better quality parts at reduced cost. By referring to **Figure Q6 (a)-(b)**, please discuss the DFMA requirements from 'Punching until Lancing'.

(14 marks)

(b) With the help of sketch, please explain the working principle of Sheet Metal Working.

(6 marks)

- END OF QUESTION -

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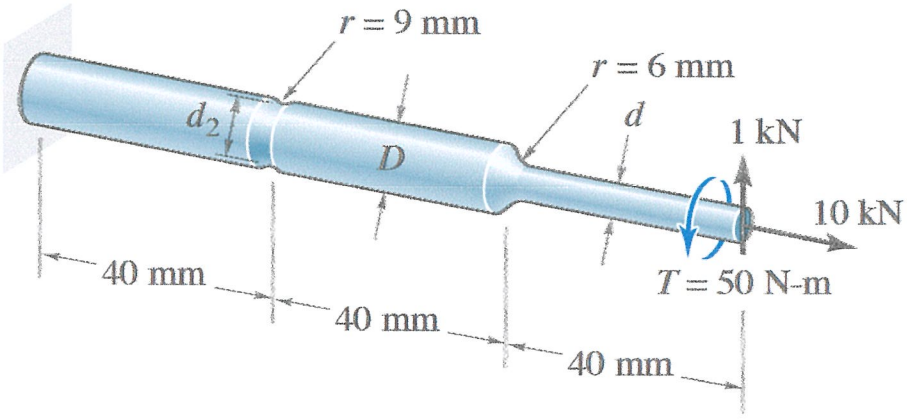

Figure Q2(a)

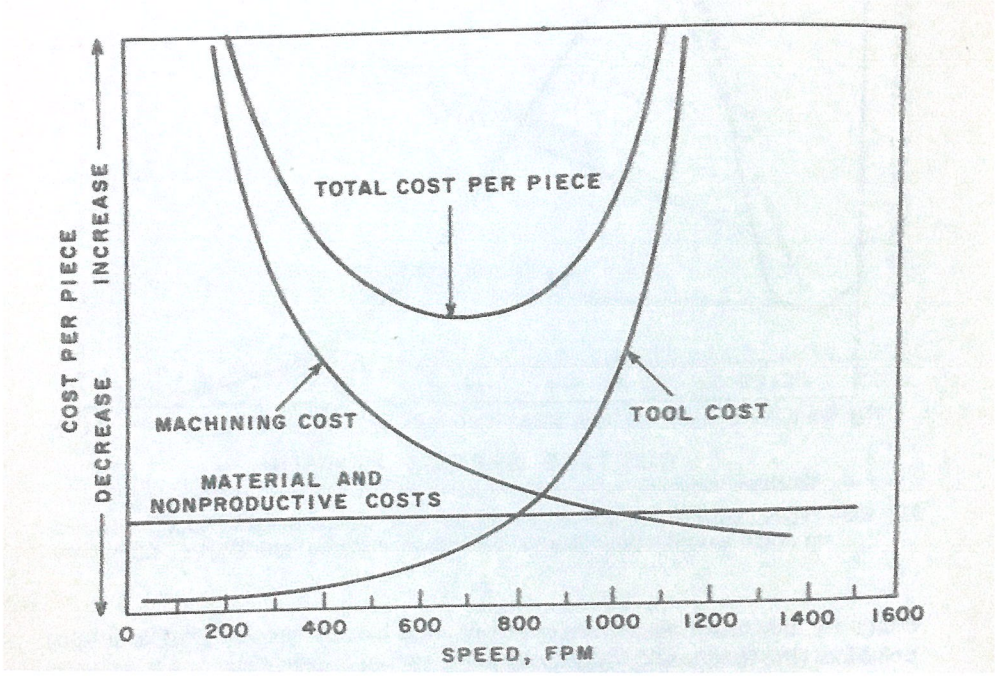

Figure Q2(b)

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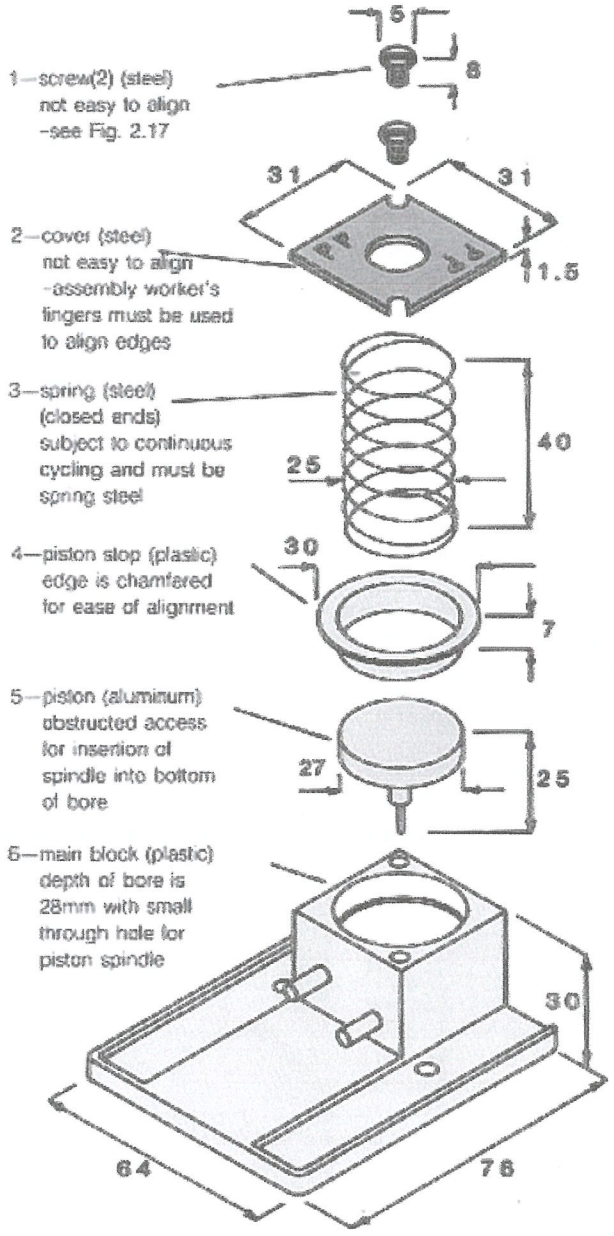

Figure Q3(a)

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Table Q3(a1)

MANUAL HANDLING—ESTIMATED TIMES (seconds)

Key: ONE HAND

			parts are easy to grasp and manipulate					parts present handling difficulties (1)				
			thickness > 2 mm			thickness ≤ 2 mm		thickness > 2 mm			thickness ≤ 2 mm	
			size >15 mm	6 mm≤ size ≤15 mm	size <6 mm	size >6 mm	size ≤6 mm	size >15 mm	6 mm≤ size ≤15 mm	size <6 mm	size >6 mm	size ≤6 mm
			0	1	2	3	4	5	6	7	8	9
parts can be grasped and manipulated by one hand without the aid of grasping tools	$(\alpha+\beta) < 360°$	0	1.13	1.43	1.88	1.69	2.18	1.84	2.17	2.65	2.45	2.98
	$360° \le (\alpha+\beta) < 540°$	1	1.5	1.8	2.25	2.06	2.55	2.25	2.57	3.06	3	3.38
	$540° \le (\alpha+\beta) < 720°$	2	1.8	2.1	2.55	2.36	2.85	2.57	2.9	3.38	3.18	3.7
	$(\alpha+\beta) = 720°$	3	1.95	2.25	2.7	2.51	3	2.73	3.06	3.55	3.34	4

ONE HAND with GRASPING AIDS

			parts need tweezers for grasping and manipulation								parts need standard tools other than tweezers	parts need special tools for grasping and manipulation
			parts can be manipulated without optical magnification				parts require optical magnification for manipulation					
			parts are easy to grasp and manipulate		parts present handling difficulties (1)		parts are easy to grasp and manipulate		parts present handling difficulties (1)			
			thickness > 0.25 mm	thickness ≤ 0.25 mm	thickness > 0.25 mm	thickness ≤ 0.25 mm	thickness > 0.25 mm	thickness ≤ 0.25 mm	thickness > 0.25 mm	thickness ≤ 0.25 mm		
			0	1	2	3	4	5	6	7	8	9
parts can be grasped and manipulated by one hand but only with the use of grasping tools	$\alpha \le 180°$	$0 \le \beta \le 180°$	4	3.6	6.85	4.35	7.6	5.6	8.35	6.35	8.6	7	7
		$\beta = 360°$	5	4	7.25	4.75	8	6	8.75	6.75	9	8	8
	$\alpha = 360°$	$0 \le \beta \le 180°$	6	4.8	8.05	5.55	8.8	6.8	9.55	7.55	9.8	8	9
		$\beta = 360°$	7	5.1	8.35	5.85	9.1	7.1	9.55	7.85	10.1	9	10

TWO HANDS for MANIPULATION

			parts present no additional handling difficulties					parts present additional handling difficulties (e.g. sticky, delicate, slippery, etc.) (1)				
			$\alpha \le 180°$			$\alpha = 360°$		$\alpha \le 180°$			$\alpha = 360°$	
			size > 15 mm	6 mm ≤ size ≤ 15 mm	size < 6 mm	size > 6 mm	size ≤ 6 mm	size > 15 mm	6 mm ≤ size ≤ 15 mm	size < 6 mm	size > 6 mm	size ≤ 6 mm
			0	1	2	3	4	5	6	7	8	9
parts severely nest or tangle or are flexible but can be grasped and lifted by one hand (with the use of grasping tools if necessary) (2)		8	4.1	4.5	5.1	5.6	6.75	5	5.25	5.85	6.35	7

TWO HANDS required for LARGE SIZE

			parts can be handled by one person without mechanical assistance									
			parts do not severely nest or tangle and are not flexible								parts severely nest or tangle or are flexible (2)	parts need special tools for grasping and manipulation
			part weight < 10 lb				parts are heavy (> 10 lb)					
			parts are easy to grasp and manipulate		parts present other handling difficulties (1)		parts are easy to grasp and manipulate		parts present other handling difficulties (1)			
			$\alpha \le 180°$	$\alpha = 360°$	$\alpha \le 180°$	$\alpha = 360°$	$\alpha \le 180°$	$\alpha = 360°$	$\alpha \le 180°$	$\alpha = 360°$		
			0	1	2	3	4	5	6	7	8	9
two hands required for grasping and transporting parts		9	2	3	2	3	3	4	4	5	7	9

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Table Q3(a2)

MANUAL INSERTION—ESTIMATED TIMES (seconds)

Key:
- PART ADDED but NOT SECURED
- PART SECURED IMMEDIATELY
- SEPARATE OPERATION

				after assembly no holding down required to maintain orientation and location (3)				holding down required during subsequent processes to maintain orientation or location (3)			
				easy to align and position during assembly (4)		not easy to align or position during assembly		easy to align and position during assembly (4)		not easy to align or position during assembly	
				no resistance to insertion	resistance to insertion (5)	no resistance to insertion	resistance to insertion (5)	no resistance to insertion	resistance to insertion (5)	no resistance to insertion	resistance to insertion (5)
				0	1	2	3	6	7	8	9
addition of any part (1) where neither the part itself nor any other part is finally secured immediately	part and associated tool (including hands) can easily reach the desired location		0	1.5	2.5	2.5	3.5	5.5	6.5	6.5	7.5
	part and associated tool (including hands) cannot easily reach the desired location	due to obstructed access or restricted vision (2)	1	4	5	5	6	8	9	9	10
		due to obstructed access and restricted vision (2)	2	5.5	6.5	6.5	7.5	9.5	10.5	10.5	11.5

				no screwing operation or plastic deformation immediately after insertion (snap/press fits, circlips, spire nuts, etc.)		plastic deformation immediately after insertion						screw tightening immediately after insertion (6)	
						plastic bending or torsion			rivetting or similar operation				
				easy to align and position with no resistance to insertion (4)	not easy to align or position during assembly and/or resistance to insertion (5)	easy to align and position during assembly (4)	not easy to align or position during assembly		easy to align and position during assembly (4)	not easy to align or position during assembly		easy to align and position with no torsional resistance (4)	not easy to align or position and/or torsional resistance (5)
							no resistance to insertion	resistance to insertion (5)		no resistance to insertion	resistance to insertion (5)		
				0	1	2	3	4	5	6	7	8	9
addition of any part (1) where the part itself and/or other parts are being finally secured immediately	part and associated tool (including hands) can easily reach the desired location and the tool can be operated easily		3	2	5	4	5	6	7	8	9	6	8
	part and associated tool (including hands) cannot easily reach desired location or tool cannot be operated easily	due to obstructed access or restricted vision (2)	4	4.5	7.5	6.5	7.5	8.5	9.5	10.5	11.5	8.5	10.5
		due to obstructed access and restricted vision (2)	5	6	9	8	9	10	11	12	13	10	12

				mechanical fastening processes (part(s) already in place but not secured immediately after insertion)				non-mechanical fastening processes (part(s) already in place but not secured immediately after insertion)				non-fastening processes	
				none or localized plastic deformation				metallurgical processes					
				bending or similar processes	rivetting or similar processes	screw tightening (6) or other processes	snap fit, snap clip, press fit, etc.	no additional material required (e.g. resistance, friction welding, etc.)	additional material required		chemical processes (e.g. adhesive bonding, etc.)	manipulation of parts or sub-assembly (e.g. orienting, fitting or adjustment of part(s), etc.)	other processes (e.g. liquid insertion, etc.)
									soldering processes	weld/braze processes			
				0	1	2	3	4	5	6	7	8	9
assembly processes where all solid parts are in place			9	4	7	5	3.5	7	8	12	12	9	12

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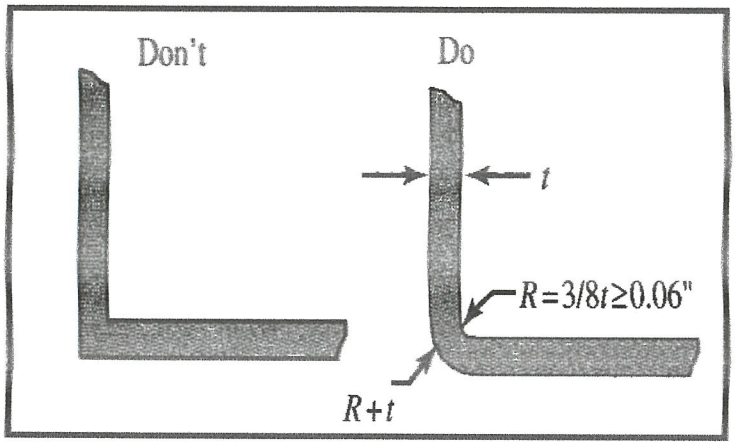

Figure Q5

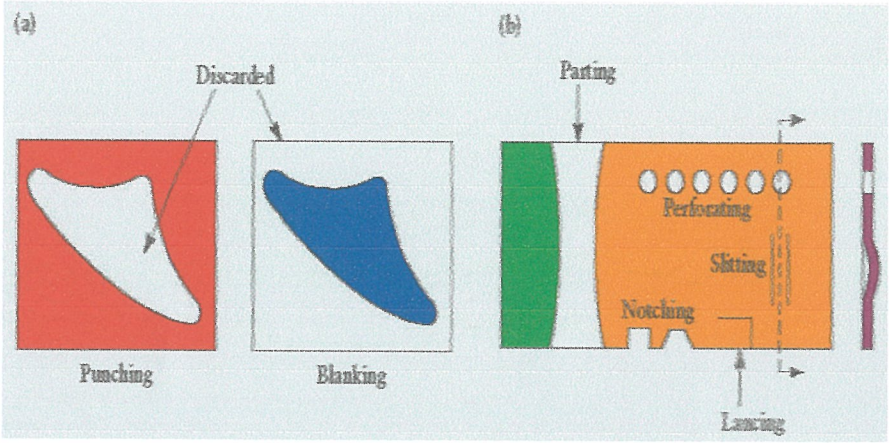

Figure Q6