Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2016/2017

COURSE NAME	:	DESIGN FOR MANUFACTURE AND ASSEMBLY
COURSE CODE	:	BNM 40103
PROGRAMME CODE	:	BNM
EXAMINATION DATE	:	DECEMBER 2016 / JANUARY 2017
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWERS **FIVE (5)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) In 'Stage-Gate Product Development Process', with the help of sketch, differentiate your sketch with explaination for each of stages starting from Idea Generation until Commercialization.

(10 marks)

(b) 'Simplicity' is one of the six basic considerations in implementing Design for Manufacture and Assembly (DFMA). With the help of sketch, list down and briefly explain five (5) important elements of the 'Simplicity'.

(10 marks)

Q2 (a) Please list down and briefly explain three (3) reasons why 'Selection of Materials' is among the very important stages in the product manufacturing.

(6 marks)

(b) List down and briefly explain three (3) reasons why we need substituting materials particularly in the development of new product.

(6 marks)

(c) With the help of sketch and explaination, justify what did you understand about 'Process Capability' particularly in DFMA aspects.

(8 marks)

Q3 (a) With the help of graph, support your graph with four (4) reasons why production cost rise exponentially, as tolerance and/or surface finish becomes increasingly fine.

(10 marks)

(b) A cylindrical work piece of copper with a 125 mm diameter and 1100 mm length is to be machined with high speed machining in turning operation. A 1000 mm portion of the length is to be turned to a diameter of 124 mm at a cutting speed of 1200 m/min and feed 0.3 mm/rev.

Solve the design parameters.

i) The required depth of cut
ii) Machining time
iii) Material removal rate

(10 marks)

Q4 (a) Determine the total operation time, total operation cost, and design efficiency for assembly shown in **Figure Q4(a)**. Assume the labor rate is RM 14.40 per hour. Refer **Tables Q4(a)(i)** and **Q4(a)(ii)** as references.

(15 marks)

(b) Design for Assembly (DFA) tool is needed as a systematic analysis in any product assembly. Identify the essential of DFA tool.

(5 marks)

Q5 (a) In 'Carry Tray Example', with the help of graph and explaination, justify the important of DFMA roles in the manual, robotic and automated manufacturing processes operations.

(10 marks)

(b) With the help of a sketch, support your sketch with four (4) elements that should be considered in implementation of Design for Machining as a part of DFMA principle and standardization.

(10 marks)

Q6 (a) The Boothroyd Dewhurst method provides a solution for Design for Assembly (DFA) developed in late 1970s by Professor Geoffrey Boothroyd, at the of Massachusetts, Amherst in cooperation with Salford University of England. With the help of sketch, justify the principles and procedures involved in the process.

(10 marks)

(b) List and differentiate five (5) summary of Design for Machining criteria should be considered in any machining operations

(10 marks)

-END OF QUESTIONS –

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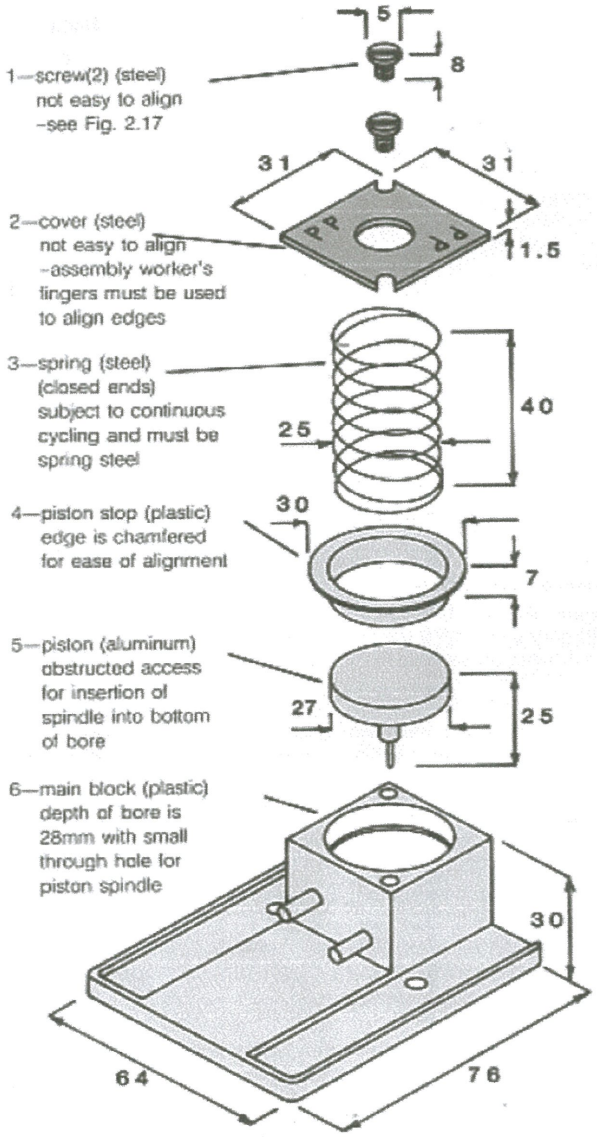

Figure Q4(a)

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Table Q4(a)(i)

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 Q4(a)(ii)

MANUAL INSERTION—ESTIMATED TIMES (seconds)

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

addition of any part (1) where				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
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

addition of any part (1) where				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 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 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)	no resistance to insertion	resistance to insertion (5)	easy to align and position during assembly (4)	no resistance to insertion	resistance to insertion (5)	easy to align and position with no torsional resistance (4)	not easy to align or position and/or torsional resistance (5)
				0	1	2	3	4	5	6	7	8	9
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					
							additional material required				
		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.)	soldering processes	weld/braze processes	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.)
		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