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SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

SEPTEMBER 2013 SESSION

SUBJECT CODE	**:**	**FIB 46503 / FIB 36504**
SUBJECT TITLE	**:**	**COMPUTER INTEGRATED MANUFACTURING**
LEVEL	**:**	**BACHELOR**
TIME / DURATION	**:**	**3 HOURS**
DATE	**:**	

INSTRUCTIONS TO CANDIDATES

1. **Please read the instructions given in the question paper CAREFULLY.**
2. **This question paper is printed on both sides of the paper.**
3. **Please write your answers on the answer booklet provided.**
4. **Answer should be written in blue or black ink except for sketching, graphic and illustration.**
5. **This question paper consists of TWO (2) sections. Section A and B. Answer ALL questions in Section A. For Section B, answer THREE (3) questions only.**
6. **Answer all questions in English.**

THERE ARE 11 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

a. What is ***Kanban***? What are the **two (2)** types of *Kanban*?

(3 marks)

b. What is 5S system? Explain briefly **all** its elements.

(3 marks)

c. There are seven forms of waste in production, as identified by Taiichi Ohno. Name and explain briefly **two (2)** of it.

(2 marks)

d. Describe the difference between **cycle time** and **takt time**.

(2 marks)

Question 2

a. What is the 5S system? (Answer could be more than one).

i. Is about standardizing the way we do things.
ii. Forms a foundation for all other improvement activities.
iii. Is a key to reducing inventory to improve lead time.
iv. Cannot be used in an office or administrative area.

(2 marks)

b. Calculate the Takt Time based on the following information:
Customer demand is 34 400 parts per month. The company works 5 days per week and on average 20 days per month. There are two, eight hour shifts. Lunch is 30 minutes per shift. Two, ten minutes breaks are taken per shift. The calculated Takt Time is:

i. 0.5 minutes per part or 30 sec. per part.
ii. 1 parts per minute or 1 part every 60 sec.
iii. 0.5 parts per minute.
iv. 1 minute per part.

(2 marks)

c. Look at items in work area, red tag, keep what's needed and eliminate what is not, and reduce number of items to what is required. This statement is the best description for:

i. Sort
ii. Set in order
iii. Shine
iv. Standardize
v. Sustain

(2 marks)

d. Making something earlier or faster than required by the next process "just-in-case" is an example of which type of waste?

i. Defect
ii. Motion
iii. Over production
iv. Over processing

(2 marks)

e. Create rules such as holding rules and responsibilities; locations, number and position of items; cleaning schedules and procedures; storage and retrieval systems; visual controls to share information and highlight conditions. This statement is the best description for:

i. Sort
ii. Set in order
iii. Shine
iv. Standardize
v. Sustain

(2 marks)

Question 3

Answer the following questions based upon the following conditions.

Product:

- Part name: 10 inch pinion gear (semi-finish)
- Part number: PG6654

Process sequence:

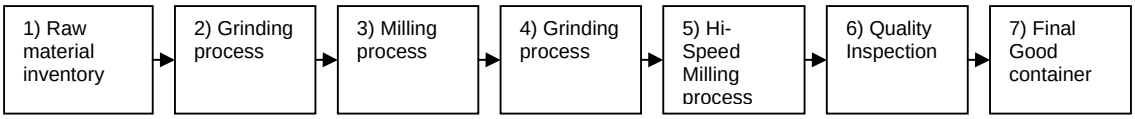


Table 1: Process sequences and details

Process Sequence	Process name	Machine number	Manual Time (sec)	Auto time (sec)	No. pieces / change	Time for tool change (sec)
1	Pick up raw material	-	1	-	-	-
2	Grinding process	GC-614	5	28	300	120
3	Milling process	CH-228	6	20	300	180
4	Grinding process	GC-1444	6	38	250	250
5	Hi Speed Milling process	CH-562	7	30	1200	600
6	Quality Inspection	-	7	-	-	
7	Place in final good container	-	2	-	-	

Manufacturing data:

- Working time is 8hrs per shift and two shifts.
- Production volume is 1200 units per day.
- Walk time between stations is 2 seconds.

a) Calculate process capacity for each machine by filling the Table 2 below. You are obliged to copy Table 2 below onto your answer booklet.

(4 marks)

Table 2: Process capacity

Step no.	Process name	Total cycle time	Tool change time per piece	Shift capacity
1	Grinding process			
2	Milling process			
3	Grinding process			
4	Hi Speed Milling process			

b) Based upon your answer for Question 3 (a), is it possible to increase the production volume to 1500 units per day? If not, what is the maximum production volume can be attained?

(4 marks)

c) Construct the standardized work combination table using the template as shown in Table 3 below and answer the following questions. You are suggested to copy Table 3 onto your answer booklet.

i. Determine the total 10 inch pinion gear's process cycle time.

(4 marks)

ii. Determine the manufacturing line takt time.

(2 marks)

iii. Is it possible to synchronize the process cycle time with the takt time?

(2 marks)

Table 3: Standardized work combination table

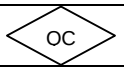
Line takt:		Legend:	Manual time (MT)	Walk time (WaT)
			Auto time (AT)	Wait time (WtT)

Step no.	MT	AT	WtT	WaT	Time Graph (sec)
1					
2					
3					
4					
5					
6					
7					

a) Construct the standardized work chart based on your answer for Question 3 (c) using template as Table 4 and also determine the amount of required standard in-process (SWIP) stock to ensure smooth operations. You are advised to copy Table 4 onto your answer booklet.

(4 marks)

Table 4: Standardized Work Chart

Takt time:					Production volume:		No of shift:	
Cycle time:					◯ Work Sequence —— Walking ----- Return to start	Safety	SWIP	Quality
Step no.	MT	AT	WtT	WaT				
1								
2								
3								
4								
5								
6								
7								

SECTION B (Total: 60 marks)

INSTRUCTION: Answer THREE (3) questions only.

Question 4

i. Table 5 lists the weekly quantities and routings of ten parts that are being considered for cellular manufacturing in a machine shop. Parts are identified by letters and machines are identified numerically.

Table 5: The weekly quantities and routings

Part	Weekly quantity	Machine routing	Part	Weekly quantity	Machine routing
A	50	$3 \rightarrow 2 \rightarrow 7$	F	60	$5 \rightarrow 1$
B	20	$6 \rightarrow 1$	G	5	$3 \rightarrow 2 \rightarrow 4$
C	75	$6 \rightarrow 5$	H	100	$3 \rightarrow 2 \rightarrow 4 \rightarrow 7$
D	10	$6 \rightarrow 5 \rightarrow 1$	I	40	$2 \rightarrow 4 \rightarrow 7$
E	12	$3 \rightarrow 2 \rightarrow 7 \rightarrow 4$	J	15	$5 \rightarrow 6 \rightarrow 1$

Determine:

a) Develop the part-machine incidence matrix.

(4 marks)

b) Apply the rank order clustering technique to the part-machine incidence matrix to identify logical part families and machine groups.

(5 marks)

ii. Five machines will constitute a GT cell. The from-to data for the machines are shown in the Table 6 below.

a) Determine the most logical sequence of machines for this data, and construct the network diagram, showing where and how many parts enter and exit the system.

(4 marks)

b) Compute the percentages of in-sequence moves, bypassing moves, and backtracking moves in the solution.

(5 marks)

c) Develop a feasible layout plan for the cell based on the solution.

(2 marks)

Table 6: Machine Cell route

From:	To:				
	1	2	3	4	5
1	0	10	80	0	0
2	0	0	0	85	0
3	0	0	0	0	0
4	70	0	20	0	0
5	20	75	0	20	0

Question 5

Table 7 show a flexible manufacturing cell consists of a manual load/unload station, three CNC machines, and an automated guided vehicle system (AGVS) with two vehicles. The vehicles deliver parts to the individual machines, drop off the parts, then go perform other work. The workstations are listed in the table below, where the AGVS is listed as station 5.

Table 7: Flexible Manufacturing Cell

Station	Description	Servers
1	Load and unload	1 worker
2	Milling	1 CNC milling machine
3	Drilling	1 CNC drill press
4	Grinding	1 CNC grinding machine
5	AGVS	2 vehicles

The FMC is used to machine four work parts. The product mix, routings, and processing times for the parts are presented in the Table 8 below.

The mean travel time of the AGVS between any two stations in the FMC is 3 min which includes the time required to transfer loads to and from the stations. Given that the loading on

the system is maintained at 10 parts (10 workparts in the system at all times), use the extended bottleneck model.

Table 8: Part Routing

Part j	Part mix p_j	Station routing	Station 1	Station 2	Station 3	Station 4	Station 1
A	0.25	1→2→3→4→1	4 min	8 min	7 min	18 min	2 min
B	0.33	1→3→2→1	4 min	9 min	10 min	0	2 min
C	0.12	1→2→4→1	4 min	10 min	0	14 min	2 min
D	0.30	1→2→4→3→1	4 min	6 min	12 min	16 min	2 min

Determine:

(a) The bottleneck station.

(6 marks)

(b) The production rate of the system and the average time to complete a unit of production.

(6 marks)

(c) The overall utilization of the system, not including the AGVS.

(8 marks)

Question 6

A 23-station transfer line has been logged for 5 days (total time = 2400 min). During this time there were a total of 158 downtime occurrences on the line shown at Table 9 below. The accompanying table identifies the type of downtime occurrence, how many occurrences of each type, and how much total time was lost for each type. The transfer line performs a sequence of machining operations, the longest of which takes 0.42 min. The transfer mechanism takes 0.08 min to index the parts from one station to the next each cycle. Assuming no parts removal when the line jams. Determine the following based on the five-day observation period:

(a) How many parts were produced,

(5 marks)

(b) Downtime proportion,

(5 marks)

(c) Production rate,

(5 marks)

(d) Frequency rate associated with the transfer mechanism failures.

(5 marks)

Table 9 : Type of Downtime at Automated Transfer Machine

Type of downtime	Number of occurrences	Total time lost
Associated with stations:		
Tool-related causes	104	520 min
Mechanical failures	21	189 min
Miscellaneous	7	84 min
Subtotal	132	793 min
Transfer mechanism	26	78 min
Totals	158	871 min

Question 7

A flexible manufacturing system is used to produce three products. The FMS consists of a load/unload station, two automated processing stations, an inspection station, and an automated conveyor system with an individual cart for each product. The conveyor carts remain with the parts during their time in the system, and therefore the mean transport time includes not only the move time, but also the average total processing time per part. The number of servers at each station is given in the following Table 10.

Table 10: Number of servers at each station

Station 1	Load and unload	2 workers
Station 2	Process X	3 servers
Station 3	Process Y	4 servers
Station 4	Inspection	1 server
Transport system	Conveyor	8 carriers

All parts follow either of two routings, which are $1 \rightarrow 2 \rightarrow 3 \rightarrow 4 \rightarrow 1$ or $1 \rightarrow 2 \rightarrow 3 \rightarrow 1$, the difference being that inspections at station 4 are performed on only one part in four for each product (f_{4jk} = 0.25). The product mix and process times for the parts are presented in the Table 11.

The move time between stations is 4 min.

Determine:

(a) Using the bottleneck model, show that the conveyor system is the bottleneck in the present FMS configuration, and determine the overall production rate of the system.

(6 marks)

(b) Determine how many carts are required to eliminate the conveyor system as the bottleneck.

(6 marks)

(c) With the number of carts determined in (b), use the extended bottleneck model to determine the production rate for the case when N = 8; that is, only eight parts are allowed in the system even though the conveyor system has a sufficient number of carriers to handle more than eight.

(8 marks)

Table 11: Product mix and process time

Product j	Part mix p_j	Station 1	Station 2	Station 3	Station 4	Station 1
A	0.2	5 min	15 min	25 min	20 min	4 min
B	0.3	5 min	10 min	30 min	20 min	4 min
C	0.5	5 min	20 min	10 min	20 min	4 min

Question 8

An eight-station automatic assembly machine has an ideal cycle time of 10 sec. Downtime is caused by defective parts jamming at the individual assembly stations. The average downtime per occurrence is 2.0 min. The fraction defect rate is 1.0% and the probability that a defective part will jam at a given station is 0.6 for all stations. The cost to operate the assembly machine is RM90.00 per hour and the cost of components being assembled is RM 0.60 per unit assembly. Ignore other costs. Determine :

(a) Yield of good assemblies,

(5 marks)

(b) Average production rate of good assemblies,

(5 marks)

(c) Proportion of assemblies with at least one defective component,

(5 marks)

(d) Unit cost of the assembled product.

(5 marks)

END OF QUESTION