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CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

SEPTEMBER 2014 SESSION

SUBJECT CODE	:	**FIB46503 / FIB36504**
SUBJECT TITLE	:	**COMPUTER INTEGRATED MANUFACTURING**
LEVEL	:	**BACHELOR**
TIME / DURATION	:	**9.00 AM – 12.00 PM (3 HOURS)**
DATE	:	**2 JANUARY 2015**

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 9 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

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

Question 1

a. 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)

b. Red tags are first used in what step of 5S?

i. Set in Order
ii. Sort
iii. Standardize
iv. Sustain

(2 marks)

c. Identify sources of containment; determines targets and assignments for cleanliness; make everything like “new”, check if replacement or repair is necessary; replace wires, hoses, tubes, etc. This statement is the best description for:

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

(2 marks)

d. The operator had to spent more work time as there are huge number of product to be rework due to the minor defect detected. This statement is the best description for:

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

(2 marks)

e. Red tags are first used in what step of 5S?

i. Set in Order
ii. Sort
iii. Standardize
iv. Sustain

(2 marks)

Question 2

a) What is the Japanese word for:

i. Waste.

(0.5 marks)

ii. Continuous improvement.

(0.5 marks)

iii. Error prevention.

(0.5 marks)

iv. Signal card.

(0.5 marks)

b) Name four (4) and briefly describe of the seven form of waste in production, as identified by Taiichi Ohno.

(4 marks)

c) What is takt time?

(2 marks)

d) The monthly usage for a component supplied to an appliance assembly plant is 5,000 parts. There are 21 working days in the month and the effective operating time of the plant is 450 min per day. Currently, the defect rate for the component is 2.2%, and the equipment used to produce the part is down for repairs an average of 22 minutes per day. Determine the takt time for this part.

(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:

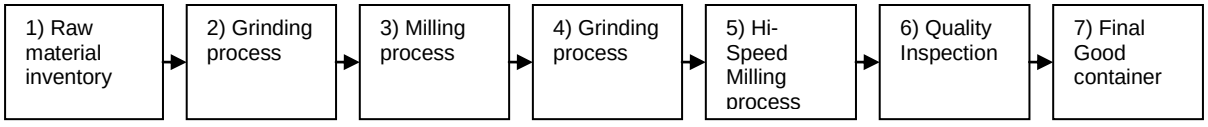

Table 1: Process sequences and details

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					

d) 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	Safety	SWIP	Quality
Step no.	MT	AT	WtT	WaT	Walking Return to start			OC
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
K	50	$3 \rightarrow 2 \rightarrow 7$
L	20	$6 \rightarrow 1$
L	75	$6 \rightarrow 5$
M	10	$6 \rightarrow 5 \rightarrow 1$
N	12	$3 \rightarrow 2 \rightarrow 7 \rightarrow 4$

Part	Weekly quantity	Machine routing
O	60	$5 \rightarrow 1$
P	5	$3 \rightarrow 2 \rightarrow 4$
Q	100	$3 \rightarrow 2 \rightarrow 4 \rightarrow 7$
R	40	$2 \rightarrow 4 \rightarrow 7$
S	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
1	0	10	80	0
2	0	0	0	85
3	0	0	0	0
4	70	0	20	0
5	20	75	0	20

Question 5

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 7

Table 7: Number of servers at each station

Station 1	Load and unload	4 workers
Station 2	Process X	6 servers
Station 3	Process Y	8 servers
Station 4	Inspection	2 server
Transport system	Conveyor	16 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 8.

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 8: 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 6

An automated assembly machine has four workstations show at Table 9. The first station presents the base part, and the other three stations add parts to the base. The ideal cycle time for the machine is 3.5 sec, and the average downtime when a jam results from a defective part is 1.5 min. The fraction defective rates (q) and probabilities that a defective part will jam the station (m) are given in the table below. Quantities of 100,000 for each of the bases, brackets, pins, and retainers are used to stock the assembly line for operation.

Table 9: Automated assembly machine

	Part identification	*q*	*m*
1	Base	0.01	1.0
2	Bracket	0.02	1.0
3	Pin	0.03	1.0
4	Retainer	0.04	0.5

Determine:

(a) Proportion of good product to total product coming off the line.

(6 marks)

(b) Production rate of good product coming off the line.

(4 marks)

(c) Total number of final assemblies produced, given the starting component quantities. Of the total, how many are good product, and how many are products that contain at least one defective component?

(6 marks)

(d) The number of defective assemblies determined in above part (c), how many will have defective base parts? How many will have defective brackets? How many will have defective pins? How many will have defective retainers?

(4 marks)

Question 7

Table 10 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 10: Flexible Manufacturing Cell

Station	Description	Servers
1	Load and unload	2 worker
2	Milling	2 CNC milling machine
3	Drilling	3 CNC drill press

4	Grinding	2 CNC grinding machine
5	AGVS	3 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 11 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 work parts in the system at all times), use the extended bottleneck model.

Table 11: 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)

END OF QUESTION