Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	MANUFACTURING CONTROL
COURSE CODE	:	BBM 40402
PROGRAMME CODE	:	BBA
EXAMINATION DATE	:	JULY / AUGUST 2023
DURATION	:	2 HOURS
INSTRUCTIONS	:	1. ANSWER ALL QUESTIONS
		2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**.
		3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

THIS QUESTION PAPER CONSIST OF **TWELVE (12)** PAGES

Q1 (a) Give two (2) importance of the manufacturing sector towards a nation.

(4 marks)

(b) Explain how product data management (PDM) promotes global manufacturing network based on its key function.

(6 marks)

(c) An engineer at an motorcycle assembly plant wishes to determine the standard time for motorcycle engine assembly process for their new motorcycle model. The assembly process for engine of each motorcycle can be done by one operator. Using time study approach, the engineer has summarized his findings for 5 random cycles of assembly process in Table Q1(c).

Table Q1(c): Time Analysis for Engine Assembly

No.	Work Elements	Cycle (Time in Seconds)				
		1	2	3	4	5
1	Engine holding and fixture	32	33	33	90*	32
2	Engine position alignment	43	42	42	42	44
3	Bolt assembly	35	36	34	35	36

*Equipment Error

(i) Assume that work element 1 and 2 have 120% performance rating and work element 3 have 110% performance rating, calculate the standard time for the whole assembly operations if allowance factor is 10%.

(7 marks)

(ii) With assumptions that the company has 20 full working days per month with 3 shifts daily (8 hours per shift) and, 2 working Saturday with 2 shifts only per month (8 hours per shift). Estimate roughly the number of motorcycles that can be assembled with completed engine assembly per month.

(4 marks)

(iii) Estimate the salary of one (1) engine assembly worker per shift if the cost for this assembly process per car is RM 0.60 using your estimation in Q1(c)(ii).

(4 marks)

Q2 (a) Explain three (3) advantages of labor specialization.

(6 marks)

(b) Explain two (2) assumptions of using the basic economic order quantity (EOQ) model.

(4 marks)

(c) The performance of a sensor controller module assembly line in an electronic components manufacturing plant is presented as in Table Q2(c).

Table Q2(c): Assembly Line Process

Task	Follower	Performance Time (minutes)
A	B	0.2
B	E	0.2
C	D	0.8
D	F,G	0.6
E	F	0.3
F	H	0.2
G	H	0.1
H	I	0.6
I	J	0.4
J	K	0.3
K	-	0.3

(i) Draw a precedence diagram for this operation.

(4 marks)

(ii) Assuming 8 hours of working per day, and daily production of 600 units of sensors, calculate the cycle time.

(3 marks)

(iii) Calculate the theoretical minimum number of workstations.

(3 marks)

(iv) Balance the assembly line by assigning tasks into workstations. What is the overall efficiency of this assembly line?

(5 marks)

Q3 (a) Explain how the concept of 5S can be applied at a convenient store (example: 7-Eleven, FamilyMart, etc.).

(10 marks)

(b) A quality control (QC) engineer performed an hourly sampling on a skincare production line. Table Q3(b) below shows the data for hourly mean sampling obtained for a moisturizer bottle filling station, with a sampling size of 100. Overtime, the population standard deviation is assumed to be 0.8.

Table Q3(b): Mean Sampling at Production Line

No.\Hour	1400	1500	1600
1	99.9	100.0	100.0
2	100.0	100.0	99.8
3	100.1	99.9	99.9
4	100.0	99.9	99.6
5	100.1	100.0	99.7

(i) Determine the upper control limit (UCL) and lower control limit (LCL) for a 99.73% (3-sigma) confidence level.

(4 marks)

(ii) Plot a simple 3-sigma mean control chart using information from Q3(c)(i) on a graph paper.

(8 marks)

(iii) Evaluate which hour the moisturizer filling operation becomes inaccurate (if any) and provide solution on what should be done with the production line.

(3 marks)

Q4 (a) Explain briefly the advantages of applying the following options in aggregate planning:
(i) Subcontracting
(ii) Influencing demand
(iii) Varying production rates through overtime or idle time

(6 marks)

(b) A local automotive spare parts distributor company is handling automotive parts that are imported from oversea countries like China and South Korea. Explain how an ERP system can potentially help the company to manage their inventories.

(9 marks)

(d) An electrical appliance company produces two types of document printer: CP100 for home use, and CP200 for office use. The product structure and the required number of components of the two printers are as shown in Figure Q4(d). Table Q4(d) shows the lead time for all the components. After a stock check, the production engineer discovered safety stocks for components as follows: 200 units of Printhead Motor 1, 1000 units of Stabilizer Bar, 500 units of Paper Roller & Feed and 300 units of System Board. Assuming the demand for CP100 is 500 units and CP200 is 800 units and both products are due in week 10, generate the net material requirements with consideration of current stock availability (*note: use the Net Requirement Planning Sheet on page 11& 12 and attach to answer sheet*).

(10 marks)

Table Q4(d): Lead Time for Components

Label	Lead Component	Lead Time (weeks)
A	CP100	2
B	CP200	2
C	Printing Subassembly 1	1
D	Printing Subassembly 2	2
E	Printhead Motor 1	1
F	Printhead Motor 2	2
G	Stabilizer Bar	1
H	Belt	1
I	Paper Roller & Feed	1
J	System Board	2

-END OF QUESTIONS-

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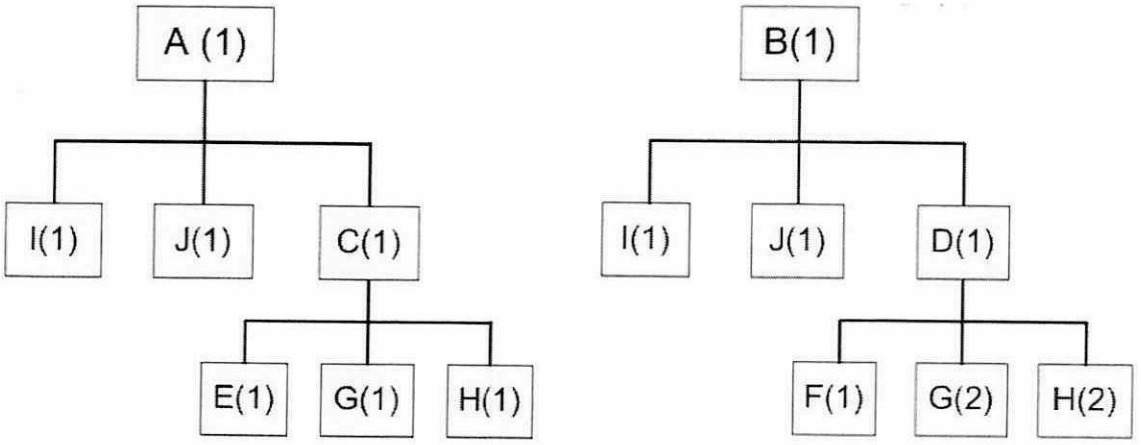

() = Number of Components

FIGURE Q4(d)

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LIST OF FORMULA

Time Studies

Average observed time = (sum of times recorded) / number of observations

Normal time = (average observed time) x (performance rating factor)

Standard time = (total normal time) / (1 – allowance factor)

$$s = \sqrt{\frac{\Sigma(x-\bar{x})^2}{n-1}} = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}}$$

$$n = \left(\frac{zs}{h\bar{x}}\right)^2$$

n = Required sample size
z = number of standard deviations required for desired level of confidence (from table)
s = standard deviation of the initial sample
$\bar{x}$ = mean of sample size
h = accuracy level desired in percent of the job element, expressed as decimal (5% = .05)

$$n = \frac{z^2 p(1-p)}{h^2}$$

n = Required sample size
z = number of standard deviations required for desired level of confidence (from table)
p = estimated value of sample proportion (of time worker is observed busy or idle)
h = acceptable error level, in percentage decimals (5% = .05)

Process Layout Analysis

$$minimize\ cost = \sum_{i=1}^{n}\sum_{j=1}^{n} X_{ij}C_{ij}$$

$n = total\ number\ of\ work\ centers\ or\ depts$

$i, j = individual\ departments$

$X_{ij} = number\ of\ loads\ moved\ from\ dept.\ i\ to\ dept.\ j$

$C_{ij} = cost\ to\ move\ a\ load\ between\ dept.\ i\ and\ dept.\ j$

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LIST OF FORMULA

Assembly Line Balancing

Cycle Time = Production time available per day / units required per day

$$minimum\ workstations = \frac{\sum_{i=1}^{n} T_i}{cycle\ time}$$

$$Efficiency = \frac{\sum Task\ times}{(actual\ number\ of\ workstations) \times (Largest\ assigned\ cycle\ time)}$$

Inventory Control

$$EOQ = \sqrt{\frac{2DS}{H}}$$

Total Cost = Carrying costs + Ordering Costs + Puchase Costs

$$TC = \frac{QH}{2} + \frac{DS}{Q} + PD$$

D = Demand, S = Ordering Cost, H = Holding Cost, Q = units per order

Statistical Process Control: Mean Chart

Upper Control Limit (UCL) = $\bar{x} + z\sigma_{\bar{x}}$
Lower Control Limit (LCL) = $\bar{x} - z\sigma_{\bar{x}}$

$\bar{x}$ = mean of the sample means or a target value set for the process
z = number of normal standard deviations (2 for 95.45%, 3 for 99.73%)
$\sigma_{\bar{x}}$ = standard deviation of the sample means = $\frac{\sigma}{\sqrt{n}}$
σ = population (process) standard deviation
n = sample size

Statistical Process Control: *p*- Chart

$$\sigma_{\bar{p}} = \sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$$

$$UCL_p = \bar{p} + z\sigma_{\bar{p}}$$

$$LCL_p = \bar{p} - z\sigma_{\bar{p}}$$

$\bar{p}$ = mean fraction defective in sample
z = number of standard deviations (2 for 95.45%, 3 for 99.73%)
$\sigma_{\bar{p}}$ = standard deviation of the sampling distribution

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LIST OF FORMULA

Job Sequencing

Average completion time = Sum of total flow time / Number of jobs

Utilization metric = Total job work (Processing Time) / Sum of total flow time

Average number of jobs in the system = Sum of total flow time / Total job work (processing) time

Average job lateness = Total late days / Number of jobs

Critical Ratio (CR) = Time Remaining / Worksdays Remaining = (Due date – Today's Due) / Work time remaining

Just-In-Time Inventory & Scheduling

$$Q^* = \sqrt{\frac{2DS}{H[1-(d/p)]}}$$

D = Annual Demand, S = Setup Cost, H = Holding Cost, d = Daily demand, p = Daily production

Number of Kanbans = (Demand during lead time + Safety Stock) / Size of container

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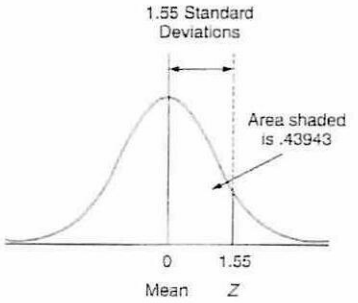
NORMAL DISTRIBUTION TABLE



As an alternative to Table I.1, the numbers in Table I.2 represent the proportion of the total area away from the mean, μ, to one side. For example, the area between the mean and a point that is 1.55 standard deviations to its right is .43943.

TABLE I.2

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.00000	.00399	.00798	.01197	.01595	.01994	.02392	.02790	.03188	.03586
0.1	.03983	.04380	.04776	.05172	.05567	.05962	.06356	.06749	.07142	.07535
0.2	.07926	.08317	.08706	.09095	.09483	.09871	.10257	.10642	.11026	.11409
0.3	.11791	.12172	.12552	.12930	.13307	.13683	.14058	.14431	.14803	.15173
0.4	.15542	.15910	.16276	.16640	.17003	.17364	.17724	.18082	.18439	.18793
0.5	.19146	.19497	.19847	.20194	.20540	.20884	.21226	.21566	.21904	.22240
0.6	.22575	.22907	.23237	.23565	.23891	.24215	.24537	.24857	.25175	.25490
0.7	.25804	.26115	.26424	.26730	.27035	.27337	.27637	.27935	.28230	.28524
0.8	.28814	.29103	.29389	.29673	.29955	.30234	.30511	.30785	.31057	.31327
0.9	.31594	.31859	.32121	.32381	.32639	.32894	.33147	.33398	.33646	.33891
1.0	.34134	.34375	.34614	.34850	.35083	.35314	.35543	.35769	.35993	.36214
1.1	.36433	.36650	.36864	.37076	.37286	.37493	.37698	.37900	.38100	.38298
1.2	.38493	.38686	.38877	.39065	.39251	.39435	.39617	.39796	.39973	.40147
1.3	.40320	.40490	.40658	.40824	.40988	.41149	.41309	.41466	.41621	.41174
1.4	.41924	.42073	.42220	.42364	.42507	.42647	.42786	.42922	.43056	.43189
1.5	.43319	.43448	.43574	.43699	.43822	.43943	.44062	.44179	.44295	.44408
1.6	.44520	.44630	.44738	.44845	.44950	.45053	.45154	.45254	.45352	.45449
1.7	.45543	.45637	.45728	.45818	.45907	.45994	.46080	.46164	.46246	.46327
1.8	.46407	.46485	.46562	.46638	.46712	.46784	.46856	.46926	.46995	.47062
1.9	.47128	.47193	.47257	.47320	.47381	.47441	.47500	.47558	.47615	.47670
2.0	.47725	.47778	.47831	.47882	.47932	.47982	.48030	.48077	.48124	.48169
2.1	.48214	.48257	.48300	.48341	.48382	.48422	.48461	.48500	.48537	.48574
2.2	.48610	.48645	.48679	.48713	.48745	.48778	.48809	.48840	.48870	.48899
2.3	.48928	.48956	.48983	.49010	.49036	.49061	.49086	.49111	.49134	.49158
2.4	.49180	.49202	.49224	.49245	.49266	.49286	.49305	.49324	.49343	.49361
2.5	.49379	.49396	.49413	.49430	.49446	.49461	.49477	.49492	.49506	.49520
2.6	.49534	.49547	.49560	.49573	.49585	.49598	.49609	.49621	.49632	.49643
2.7	.49653	.49664	.49674	.49683	.49693	.49702	.49711	.49720	.49728	.49736
2.8	.49744	.49752	.49760	.49767	.49774	.49781	.49788	.49795	.49801	.49807
2.9	.49813	.49819	.49825	.49831	.49836	.49841	.49846	.49851	.49856	.49861
3.0	.49865	.49869	.49874	.49878	.49882	.49886	.49889	.49893	.49897	.49900
3.1	.49903	.49906	.49910	.49913	.49916	.49918	.49921	.49924	.49926	.49929

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Net Requirement Planning Sheets

Item		Period (Week, Day)											
		1	2	3	4	5	6	7	8	9	10	11	12
	Gross Requirement												
	Scheduled Receipts												
	Projected on Hand												
	Net Requirements												
	Planned Order Receipts												
	Planned Order Releases												

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*Pencil written answers are acceptable on this sheet.

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