Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	PRODUCTION CONTROL
COURSE CODE	:	BBM 40402
PROGRAMME CODE	:	BBA
EXAMINATION DATE	:	JULY 2024
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTIONS	:	1. ANSWER ALL QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ 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 CONSISTS OF **ELEVEN (11)** PAGES

Q1 (a) Describe the definition of production planning and production control.

(4 marks)

(b) Explain the basic principles of production management with example.

(8 marks)

(c) An engineer in Masda Automotive plant wishes to determine the standard time for vehicle front seat assembly process for their new sports-utility vehicle (SUV). The assembly process for front seats of each car is done by two operators: one operator for left seat assembly and another operator for right seat assembly. Using time study approach, and assuming car seats are assembled simultaneously by the two operators, the engineer has summarized his findings for 5 random cycles of assembly process in **Table Q1(c)**.

Table Q1(c): Time Analysis for Door Assembly

No.	Work Elements	Cycle Time (Time in Seconds)				
		1	2	3	4	5
1	Seat holding and jig fixture	22	23	23	29*	22
2	Seat alignment	33	32	32	32	34
3	Bolt assembly	25	26	24	25	26

**Equipment error*

(i) Assume that work element 1 and 2 have 115% performance rating and work element 3 have 105% 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, and 4 working Saturday with 2 shifts only per month (8 hours per shift), estimate roughly the number of cars that can be assembled with completed front seat assembly per month.

(4 marks)

(iii) Estimate the salary of a front seat assembly worker per shift if the cost for this assembly process per car is RM 0.60 using your estimation in Q1(ii).

(2 marks)

Q2 (a) Explain two (2) types of production with example.

(4 marks)

(b) By using a suitable diagram, please explain the phases of product lifecycle.

(6 marks)

(c) The performance of an electronic sensor module assembly line in the Fujitsi Manufacturing company is presented in **Table Q2(c)**.

Table Q2(c): Time Analysis for Electronic Sensor Assembly

Task	Follower	Performance Time (in Minutes)
A	B	0.2
B	E	0.2
C	D	0.8
D	F	0.6
E	F	0.3
F	G	1.0
G	H	0.4
H	-	0.3

(i) Draw a precedence diagram for this operation.

(5 marks)

(ii) Assuming 8 hours of working per day, and daily production of 400 units of sensor modules, calculate the cycle time.

(2 marks)

(iii) Calculate the theoretical minimum number of workstations.

(2 marks)

(iv) Balance the assembly line by assigning tasks into workstations. Calculate the overall efficiency of this balanced assembly line.

(6 marks)

Q3 (a) CK Pharmaceuticals Sdn. Bhd, a company that markets painless hypodermic needles to hospitals, would like to reduce its inventory costs by determining the optimal number of hypodermic needles to obtain per order. The annual demand for these needles is 1,000 units, setup or ordering cost is RM10 per order; and the annual holding cost per unit is RM0.50. This company has a 250 working days per year.

(i) Calculate the optimal number of units per order.

(2 marks)

(ii) Calculate the total annual inventory cost.

(2 marks)

(iii) Due to weaker currency rates, annual setup cost and holding cost have experienced 10% increment while annual demand has dropped to 700 units. Calculate the changes compare to the original total annual inventory cost.

(6 marks)

(b) A quality engineer is monitoring the performance of 20 assembly lines of a IoT controller chip using online monitoring technology. The performance for each assembly line (measured using defects per 1,000 products) for a particular day is summarised as in **Table Q3(b)**.

Table Q3(b): Defects per Assembly Line

Line No.	Defects	Line No.	Defects
1	7	11	17
2	5	12	9
3	20	13	14
4	10	14	4
5	11	15	9
6	8	16	8
7	12	17	12
8	9	18	4
9	6	19	6
10	13	20	16

(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 p-chart using information from **Q3(c)(i)** on graph paper. (Please attach your graph paper to your answer script).

(8 marks)

(iii) Determine the assembly line(s) with unacceptable defect rates (if any) and provide evaluation on what should be done with the problematic assembly line(s).

(3 marks)

Q4 (a) Explain the key differences between MRP and MRP II.

(4 marks)

(b) Evergreen Furniture has designed a five-drawer file cabinet, code-named T5D, for small office home office (SOHO) users. The product structure is as shown in **Table Q4(b)** (and **APPENDIX A**) with numbers of components or subassemblies and lead time indicated.

Table Q4(b): Lead Time for Components

Lead Component	Lead Time (weeks)
T5D File Cabinet	2
Cabinet Frame	2
Drawer Assemblies	2
Drawer Frame	1
Slide Assemblies	2
Bearing	3

(i) A production engineer is assigned to ensure that 100 units of T5D cabinet are ready in week 10. Generate the gross material requirements for this demand.

(6 marks)

(ii) After a stock check, the engineer found that there are 10 units of T5D, 50 units of drawer assemblies and 200 units of bearing readily available in the warehouse. In order to meet the 100 units demand in week 10, generate the net material requirements with consideration of stock availability (note: use the Net Requirement Planning Sheet on page 11. Please attach the sheet to your answer script).

(6 marks)

(c) A machining centre has received job tasks as shown in **Table Q4(c)**. Jobs are logged as they arrived. Choose the best job sequence according to the following rules:

Table Q4(c): Job Task for Machining Centre

Job	Processing (Days)	Due Date (Days)
A	2	5
B	8	8
C	6	12
D	4	10
E	1	4

(i) First-come, first-served (FCFS).

(ii) Shortest Processing Time (SPT).

(iii) Earliest Due Date (EDD).

(9 marks)

- END OF QUESTIONS -

APPENDIX A

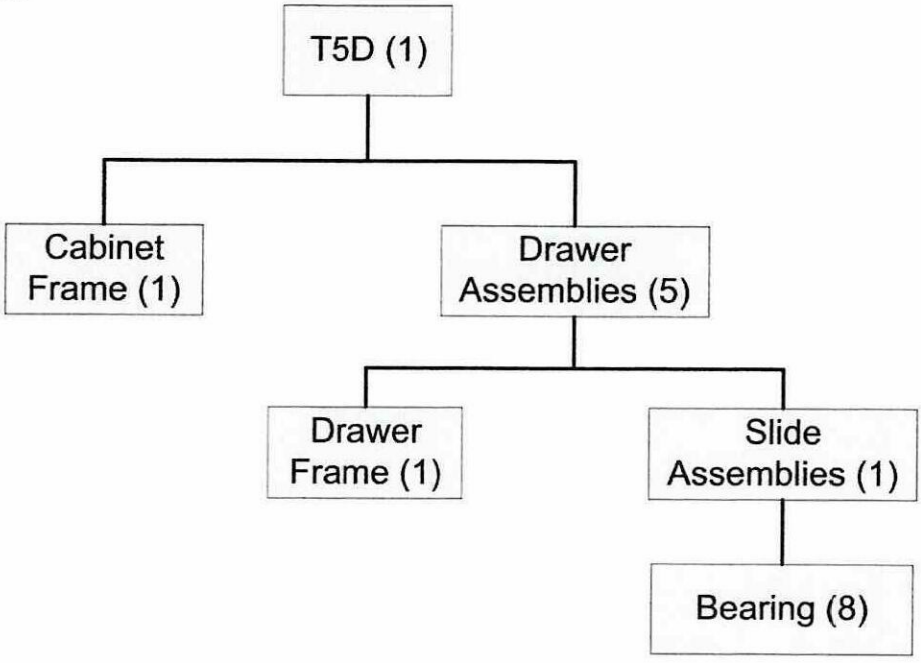


Figure Q4(b): T5D Product Structure

APPENDIX B LIST OF FORMULA

a) 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)

b) Process Layout Analysis

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

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

$i,j = individual\ departments$

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

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

c) 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

d) 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

e) Statistical Process Control: *p*-Chart

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

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

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

$\bar{p}$ = mean fraction defective in sample

z = number of standard deviations (2 for 95.45%, 3 for 99.73%)

$\sigma_{\hat{p}}$ = standard deviation of the sampling distribution

f) 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

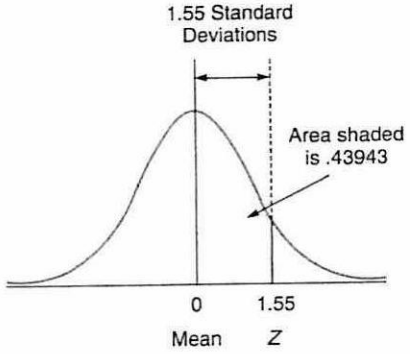
g) Just-In-Time Inventory & Scheduling

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

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

APPENDIX C 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

APPENDIX D (Answer Sheets for Q4(b)(ii)

NAME:

MATRIC NO.: TABLE NO:

Instruction: Please attach this sheet together with your answer script and graph paper. Pen and pencil written answer are acceptable on this sheet.

MATERIAL 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												

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												

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												

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												

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												

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												