Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	INDUSTRIAL ENGINEERING
COURSE CODE	:	DAM23702
PROGRAMME CODE	:	DAM
EXAMINATION DATE	:	JULY 2024
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTIONS	:	1. ANSWER **FOUR (4)** QUESTIONS ONLY 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

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

Q1 Industrial engineers play a vital role in optimizing various aspects of production processes to enhance efficiency and productivity. In the context of transportation methods and minisum principles, consider the following scenario:

(a) Describe how industrial engineers improve transportation methods in factories and companies and their objectives in doing so.

(5 marks)

(b) Given a scenario where a manufacturing company needs to transport raw materials from three owns factories in three towns (A, B, and C), which distribute to two customer shops in two other cities (X, and Y). The transportation costs per unit distance for each supplier-production line pair are shown in **Table Q1.1**.

Table Q1.1

From/To	X	Y	Production Capacity
A	RM14	RM11	800
B	RM13	RM12	1200
C	RM9	RM10	500
Demand	1500	1000	

(i) Draw the transportation table.

(4 marks)

(ii) Determine the total transportation cost using least cost method.

(6 marks)

(c) Zlaton Sdn Bhd plans to construct a new facility, aiming to be close to its five main suppliers to reduce transportation costs for bulky materials. The suppliers' current coordinates are: S1=(1,1), S2=(5,2), S3=(2,8), S4=(4,4), and S5=(8,6). Despite consistent transportation costs per unit distance, the number of daily trips between the facility and each supplier varies: 5, 6, 2, 4, and 8 respectively. Using the minisum principle to minimize overall transportation costs,

(i) Determine the coordinate (x,y) of the new facility.

(6 marks)

(ii) Calculate the total cost.

(4 marks)

Q2 Enhancing efficiency and productivity across industries often relies on effective job design strategies and practical methodologies like direct time study.

(a) Define job design in the context of industrial engineering.

(2 marks)

(b) Give three (3) examples approaches / component in job design.

(3 marks)

(c) Ali has recorded the assembly times for an assembly of watches as shown in **Table Q2.1**. Using the provided data, determine:

Table Q2.1

Work Element	Observation (second)		
	1	**2**	**3**
1	14	15	16
2	14	12	10
3	24	24	24
4	9	10	8

(i) The average time taken for assembling the watch.

(4 marks)

(ii) The normal time for assembling the watch, considering a performance rating of 90%.

(4 marks)

(iii) The standard time taken by Ali, based on a performance rating of 90% and total allowance of 10%.

(5 marks)

(iv) The unit of watch produced by an operator in a day.

(2 marks)

(v) The number of operators required for the assembly process if Ali plan to produce 96000 unit per month. (Assume the company operating 20 days per month and a single 8-hour shift per day).

(2 marks)

(vi) Labour cost per unit watch if the salary is RM1600 per month.

(3 marks)

Q3 In operational planning, companies typically use various strategies to manage production and meet demand effectively. Aggregate planning plays a crucial role in determining production levels, scheduling, workforce size, and inventory levels over a specified period.

(a) Explain the two (2) planning strategies for an aggregate plan.

(5 marks)

(b) The demand for the types of defence machinery for a certain project is given each month as shown in **Table Q3.1.**

Table Q3.1

Demand	Month								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
A	20	15	25	15	40	60	45	30	25
B	40	45	50	25	40	50	30	35	15
C	80	75	35	65	60	50	70	65	85

(i) Examine the total forecast for the month of 10 using a weight of 0.4 for the most recent period, 0.3 for the next most recent period, 0.20 for the next period, and 0.1 for the next recent period.

(5 marks)

(ii) Examine the total forecast demand for period 10 using a linear regression.

(15 marks)

Q4 Understanding how TQM enhances scheduling efficiency and inventory management is vital for businesses seeking sustained success and market leadership.

(a) Explain how Total Quality Management (TQM) contributes to enhancing a company's competitive position in the marketplace.

(5 marks)

(b) Aminah must prepare an annual report for the Annual General Meeting (AGM) event for her customers. Therefore, Aminah has 5 chapters on her desk that must be typed and proofed as soon as possible. Aminah does the typing; the author does the proofing. Some chapters are easy to type but difficult to proofread. The estimated time (in minutes) for each activity is given in **Table Q4.1**.

Table Q4.1

Chapter	Estimated time (minutes)	
	Typing	Proofing
1	30	20
2	40	40
3	60	15
4	45	30
5	75	60

(i) Suggest the optimum sequence for scheduling the chapters in the report.

(5 marks)

(ii) Based on suggestion at **Q4(b)(i)**, calculate the total makespan and total idle time.

(5 marks)

(c) Al-Hafiz Hardware (M) Sdn Bhd stocks certain pipeline equipment at its central warehouse for domestic hardware shop supply. The yearly demand for these pipeline equipment is 12,500 units. The cost of each unit is RM 60, and the inventory carrying cost is RM 10 per unit per year. The average ordering cost is RM 25 per order. It takes about 5 days for an order to arrive, and the demand for 1 week is 150 units. (This is a corporate operation and there are 250 working days per year)

(i) Calculate the expected number of orders placed each year.

(5 marks)

(ii) Calculate the expected time between orders.

(2 marks)

(iii) Estimate the total annual inventory cost.

(3 marks)

Q5 7 QC Tools are also known as Seven Basic Quality Tools and Quality Management Tools, which can assist an organization for problem solving and process improvement.

(a) One of the 7 QC Tools is Histogram. Describe the purpose of Histogram as a pictorial representation of a set of data.

(5 marks)

(b) The supervisor of a company has collected a sample of mobile phone assembly time data as shown in **Figure Q5.1**.

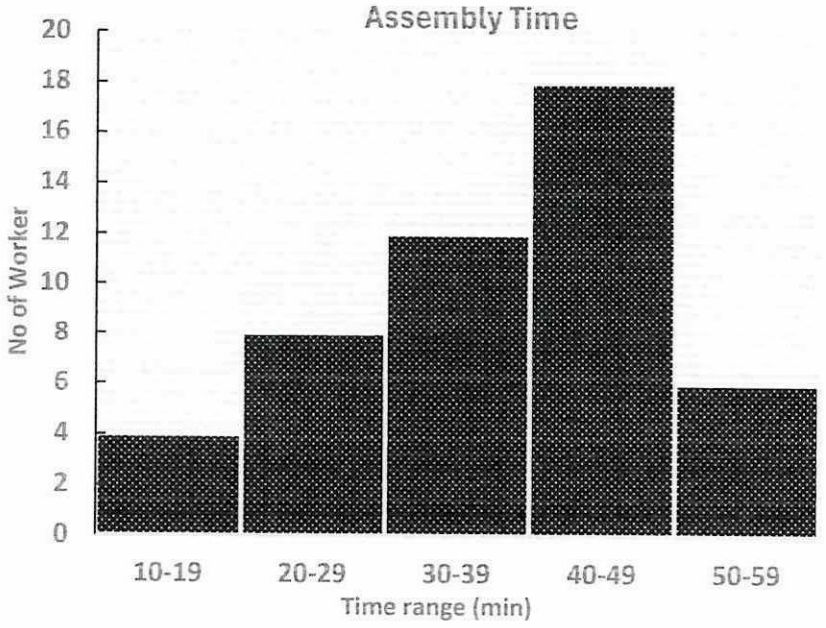

Figure Q5.1

(i) Calculate the total number of workers sampled.

(2 marks)

(ii) The number of workers who took less than 30 minutes to complete an assembly process.

(2 marks)

(iii) The percentage of workers who took more than 50 minutes to complete an assembly process.

(2 marks)

(iv) If total number of workers is 100, state the percentage of data sampled

(2 marks)

(c) Advanced Machining Sdn. Bhd is a company that produces motorcycle shaft and operates 24 hours a day. Each machine can produce up to 20 lots per day. Staffs from the quality department will take 4 samples for inspection on the critical shaft diameter. The data in **Table Q5.1** shows the results of the measurements taken on the shaft diameter. Prepare an X-bar Chart and an R Chart for this process. Refer to **Table APPENDIX A1** to answer the question

Table Q5.1

Subgroup Number	Diameter (mm)			
	X_1	X_2	X_3	X_4
1	2.12	2.14	2.12	2.11
2	2.12	2.12	2.18	2.16
3	2.11	2.17	2.11	2.15
4	2.11	2.16	2.13	2.13
5	2.11	2.18	2.13	2.12
6	2.11	2.15	2.16	2.11
7	2.11	2.15	2.18	2.13
8	2.19	2.18	2.16	2.19
9	2.18	2.18	2.14	2.19
10	2.14	2.20	2.19	2.16

(12 marks)

Q6 JIT (Just in Time) is a Japanese management philosophy which has been applied in practice since the early 1970s in many Japanese manufacturing organisations. It was first developed and perfected within the Toyota manufacturing plants by Taiichi Ohno as a means of meeting consumer demands with minimum delays.

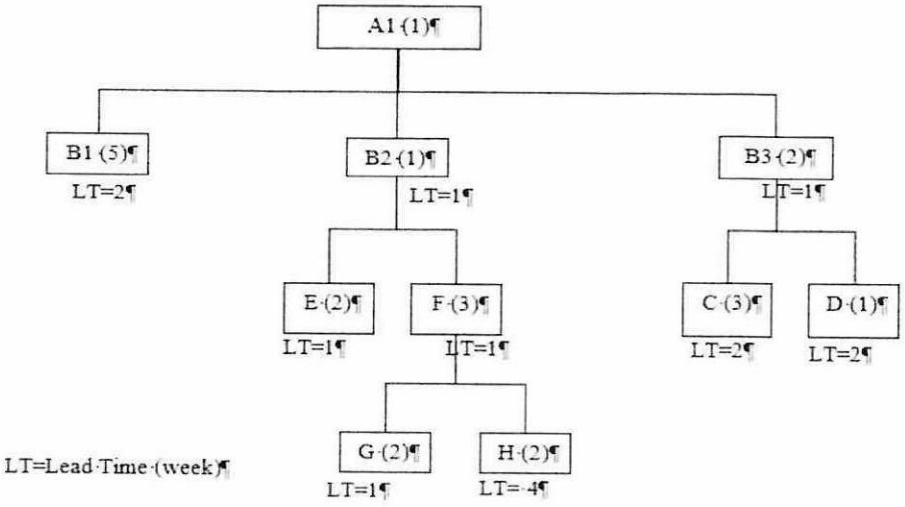

Figure 6.1

(a) Explain JIT and list out one of its main principles with an explanation.

(5 marks)

(b) **Figure Q6.1** shows the product structure, calculate the lead time to produce product A1

(3 marks)

(c) **Figure Q6.1** illustrates the product structure of A1. Customer demand information and inventory status for each item are presented in Table **Q6.1** and **Table Q6.2** respectively. Provide material requirement planning (MRP) for items A1, B3, C, and D.

(17 marks)

Table Q6.1

Week	4	5	6	7	8	9
Demand			88	90		120

Table Q6.2

Item	Rule	Lead time (week)	On-hand inventory	Item	Rule	Lead time (week)	On-hand inventory
B1	FOQ=50	2	50	E	FOQ=50	1	0
B2	POQ (P=2)	1	60	F	L4L	1	0
B3	FOQ=50	1	79	G	FOQ=400 safety stock = 100	1	200
C	FOQ=70	2	14	H	FOQ=100	4	3
D	FOQ=50	2	17	A1	L4L	1	0

- END OF QUESTIONS -

APPENDIX A

Table APPENDIX A.1

Factors for Computing Central Lines and 3σ Control Limits for $\bar{X}$, s and R Charts.

OBSERVATIONS IN SAMPLE, n	CHART FOR AVERAGES: FACTORS FOR CONTROL LIMITS A	A_2	A_3	CHART FOR STANDARD DEVIATIONS: FACTOR FOR CENTRAL LINE c_4	FACTORS FOR CONTROL LIMITS B_1	B_4	B_5	B_6	CHART FOR RANGES: FACTOR FOR CENTRAL LINE d_2	FACTORS FOR CONTROL LIMITS d_1	D_1	D_2	D_3	D_4
2	2.121	1.880	2.659	0.7979	0	3.267	0	2.606	1.128	0.853	0	3.686	0	3.267
3	1.732	1.023	1.954	0.8862	0	2.568	0	2.276	1.693	0.888	0	4.358	0	2.574
4	1.500	0.729	1.628	0.9213	0	2.266	0	2.088	2.059	0.880	0	4.698	0	2.282
5	1.342	0.577	1.427	0.9400	0	2.089	0	1.964	2.326	0.864	0	4.918	0	2.114
6	1.225	0.483	1.287	0.9515	0.030	1.970	0.029	1.874	2.534	0.848	0	5.078	0	2.004
7	1.134	0.419	1.182	0.9594	0.118	1.882	0.113	1.806	2.704	0.833	0.204	5.204	0.076	1.924
8	1.061	0.373	1.099	0.9650	0.185	1.815	0.179	1.751	2.847	0.820	0.388	5.306	0.136	1.864
9	1.000	0.337	1.032	0.9693	0.239	1.761	0.232	1.707	2.970	0.808	0.547	5.393	0.184	1.816
10	0.949	0.308	0.975	0.9727	0.284	1.716	0.276	1.669	3.078	0.797	0.687	5.469	0.223	1.777
11	0.905	0.285	0.927	0.9754	0.321	1.679	0.313	1.637	3.173	0.787	0.811	5.535	0.256	1.744
12	0.866	0.266	0.886	0.9776	0.354	1.646	0.346	1.610	3.258	0.778	0.922	5.594	0.283	1.717
13	0.832	0.249	0.850	0.9794	0.382	1.618	0.374	1.585	3.336	0.770	1.025	5.647	0.307	1.693
14	0.802	0.235	0.817	0.9810	0.406	1.594	0.399	1.563	3.407	0.763	1.118	5.696	0.328	1.672
15	0.775	0.223	0.789	0.9823	0.428	1.572	0.421	1.544	3.472	0.756	1.203	5.741	0.347	1.653
16	0.750	0.212	0.763	0.9835	0.448	1.552	0.440	1.526	3.532	0.750	1.282	5.782	0.363	1.637
17	0.728	0.203	0.739	0.9845	0.466	1.534	0.458	1.511	3.588	0.744	1.356	5.820	0.378	1.622
18	0.707	0.194	0.718	0.9854	0.482	1.518	0.475	1.496	3.640	0.739	1.424	5.856	0.391	1.608
19	0.688	0.187	0.698	0.9862	0.497	1.503	0.490	1.483	3.689	0.734	1.487	5.891	0.403	1.597
20	0.671	0.180	0.680	0.9869	0.510	1.490	0.504	1.470	3.735	0.729	1.549	5.921	0.415	1.585