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**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2022/2023**

COURSE NAME : INDUSTRIAL ENGINEERING

COURSE CODE : BDA 40703

PROGRAMME CODE : BDD

EXAMINATION DATE : JULY / AUGUST 2023

DURATION : 3 HOURS

INSTRUCTION : 1. PART A: ANSWER **ALL** QUESTIONS.  
2. PART B: ANSWER **ONE (1)** FROM **TWO (2)** QUESTIONS PROVIDED.  
3. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**.  
4. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

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## PART A: ANSWER ALL QUESTIONS.

- Q1** (a) Discuss **FOUR (4)** roles of Industrial Engineer. (4 marks)
- (b) Anthropometry means "measurement of people". More formally, it is the study of the size, shape and strength of the human body, including, mass, volumes, mobility, proportions, centres of gravity, and inertial properties of the whole body and body segments.
- (i) Explain **FOUR (4)** use of anthropometric data in design stage. (4 marks)
- (ii) Workplace design should fit between humans, machines, and environment. Designer must analyse the special requirements of the people and design the workplace appropriately. Compare workplace design requirements for the largest and smallest users, and explain each of them. (4 marks)
- (c) Currently, TZY Manufacturing company is facing issues related to the excessive inventories, and high number of defects. As an Industrial Engineer, evaluate the situation and write appropriate recommendations on how the company can overcome the inventories and defects issues. Provide justification, elaboration and / or illustration to support your recommendation. (8 marks)

**Q2** Panasoho Corporation currently has two manufacturing plants at location A and B that supply refrigerators to four distribution centres at location U, V, W and X. Due to an increase demand of refrigerators for several years, Panasoho Corporation has decided to build another plant either at location C or D. The unit transportation costs, expected demand at four distribution centres and the maximum capacity at location A and B plants are given in **Table Q2**.

- (a) Solve the total supply capacity of the new plant (Z). (2 marks)
- (b) Using 'Location Transportation Model', evaluate the given transportation cost information and justify the most economic plant location between C or D. Support your justification with appropriate table and calculation. (18 marks)

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**Table Q2:** Costs, demand, and supply capacity information

Location	U	V	W	X	Supply Capacity
A	RM 10	RM 15	RM 22	RM 20	250
B	RM 19	RM 15	RM 10	RM 9	300
C	RM 21	RM 11	RM 13	RM 6	Z
D	RM 17	RM 8	RM 18	RM 12	
Demand	200	100	300	280	

**Q3** Aloha company is a company that manufactures a wide range of paints for decorative and industrial use. In production line, this company have their 4 major work tasks based on several processes including raw material supply (Task 1), manufacture of the product (Task 2), quality control and production evaluation (Task 3) as well as transportation and distribution process (Task 4) as shown in **Figure Q3**. Meanwhile, **Table Q3** shows the cycle time needed for each of the processes. In addition, total allowance for normal time was 18% and workers performance rating was 115%.

- (a) Based on **Figure Q3** and **Table Q3**, analyse and calculate the standard time for direct time study. (6 marks)
- (b) If the workers wage is RM2.50 per hour, analyse the labour cost for each product. (4 marks)
- (c) Work sampling study was conducted for 6 consecutive days at the Aloha company. A total of 45 observations were made during the 8-hour working period for each day. The number of units managed to be produced are 2500 units for 1 week. The factory is operating 6 days a week with productive percentage was 94%. Using the provided data with the same rating and allowance percentage, analyse and calculate the standard time for work sampling. (6 marks)
- (d) Explain **TWO (2)** advantages and disadvantages of performing work sampling rather than using direct time study. (4 marks)

**Table Q3:** Cycle time data for the production line based on work task (unit in second)

Task	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5
1	14	13	13	14	12
2	(Average value from Task 1) + 23				
3	(Average value from Task 4) + 18				
4	12	10	11	11	12

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- Q4** (a) Selesa Resort has 1200 rooms to be offered to the clients. Daily demand for mineral water is two bottles for each room. Ordering cost is RM 5 and the holding cost is RM 1 per unit per year. The delivery times from supplier are five days. The resort operates 365 days every year.
- (i) Solve the Economic Order Quantity (EOQ) for the mineral water bottles. (3 marks)
  - (ii) Based on EOQ obtained in **Q4(a)(i)**, calculate the optimal total annual inventory cost. (3 marks)
- (b) Canon Inc. is a Japanese multinational corporation headquartered in Ōta, Tokyo, specializing in optical, imaging, and industrial products, such as lenses, cameras, medical equipment, scanners, printers, and semiconductor manufacturing equipment. Five jobs are waiting to be assigned at Canon Inc. manufacturing company. **Table Q4** shows the scheduling data which involves the jobs (in the order they arrived), processing time, and due date for the jobs.
- (i) Analyse the schedules based on given data using First Come First Serve (FCFS), Earliest Due Date (EDD), and Shortest Processing Time (SPT) rules. Support your analysis with suitable table and calculation. (9 marks)
  - (ii) Based on the answer in **Q4(b)(i)**, justify the most appropriate sequencing rules if 'Delivery Time' is the main criteria. Support your justification with calculation analysis. (5 marks)

**Table Q4:** Job processing data

Job	Processing time (days)	Due date (days)
A	8	12
B	4	8
C	10	20
D	6	18
E	12	26

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PART B: ANSWER ONE (1) FROM TWO (2) QUESTIONS.

- Q5** (a) Explain the differences between product and service quality using Garvin's quality dimensions. Support your comparison with elaboration and example. (4 marks)
- (b) The product tree structure in **Figure Q5** shows the components required to assemble one unit of product A. The assembly department to begin final assembly according to the following schedule: 100 units in week 2, 200 units in week 4, 120 units in week 6, 180 units in week 7, and 60 units in week 8. Inventory records are shown in **Table Q5**. Evaluate the given data and recommend the material requirement planning for item B, C, D and E. (16 marks)

**Table Q5:** Inventory record

Item / Component	B	C	D	E
Lot-sizing rule	POQ (P=3)	L4L	FOQ = 500	L4L
Lead time	1 week	2 weeks	3 weeks	1 week
Schedule receipt	None	200 (week 1)	None	500 (week 1)
Beginning (on hand) inventory	20	0	425	100

- Q6** (a) Compare between push and pull production system. Support your comparison with elaboration and/or example. (4 marks)
- (b) Bandar Tasik Utama collects the following recyclable waste from its residents: glass, plastic, paper, aluminum, yard waste, and iron. One of its main aims for next year is to encourage residents to reuse the recyclables as much as possible before disposing of them. **Table Q6** shows data regarding how much waste of each category was recycled during the previous year.

**Table Q6:** Data related to recycled waste

No	Recycled Waste	Number of Tons
1	Glass	200
2	Plastic	50
3	Paper	800
4	Aluminium	260
5	Yard waste	200
6	Iron	210

- (i) You are required to evaluate the categories of waste that contribute the most to the total waste. Recommend an appropriate Quality Control Tool for graphically representing this situation. Support your recommendation by creating the appropriate quality control tool.  
(10 marks)
- (ii) You should be able to identify the category of recycled waste that contributes the most to the total waste in **Q6(b)(i)**. Recommend a suitable Quality Control Tool to create a snapshot of possible causes related to this main issue. Support your recommendation by creating the appropriate quality control tool.  
(6 marks)

- END OF QUESTIONS -

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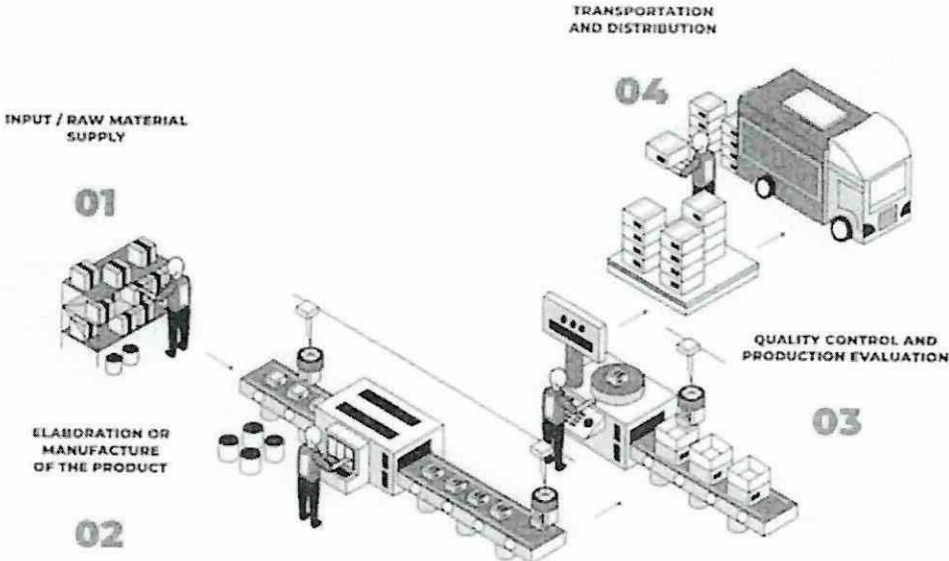


Figure Q3: Major work tasks based on several processes

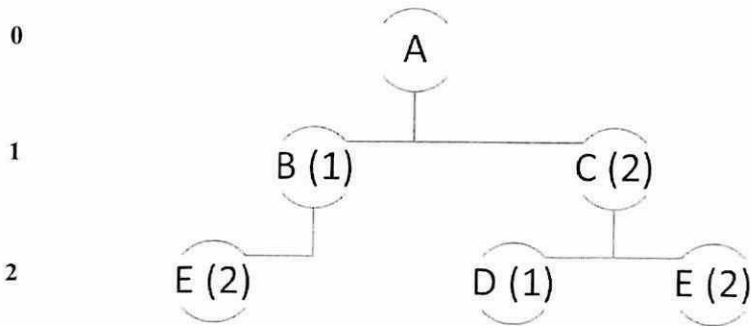


Figure Q5: Product tree structure

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## EQUATIONS

$$f(x, y) = \sum_{i=1}^n w_i (|x - a_i| + |y - b_i|)$$

$$\bar{X} = \frac{\sum \bar{X}}{g}$$

$$\bar{R} = \frac{\sum R}{g}$$

$$UCL_R = D_4 \bar{R}$$

$$LCL_R = D_3 \bar{R}$$

$$UCL_{\bar{x}} = \bar{x} + A_2 \bar{R}$$

$$LCL_{\bar{x}} = \bar{x} - A_2 \bar{R}$$

$$\text{Standard Time} = \frac{\text{Normal Time}}{1 - \text{Allowance}}$$

$$\text{Normal Time} = \text{Average cycle time} \times \text{Rating}$$

$$\text{Standard time} = \frac{\text{Total observation time}}{\text{Total output}} \times \text{Productive \%} \times \text{Rating} \times \frac{1}{1 - \text{allowance}}$$

$$\text{Annual Inventory Cost} = \frac{D}{Q^*} S + \frac{Q^*}{2} H$$

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