Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	INDUSTRIAL ENGINEERING
COURSE CODE	:	BDA 40703
PROGRAMME	:	4 BDD
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTION IN **SECTION A** AND **FOUR(4)** FROM FIVE(5) QUESTIONS IN **SECTION B**

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

SECTION A
Answer all questions in this section.

Q1 (a) Industrial engineers apply science, mathematics, and engineering methods in complex system integration and operations. Differentiate between the job scopes of Industrial Engineers in quality control and logistics department.
(4 marks)

(b) Briefly discuss **FOUR (4)** advantages of ergonomics concepts application in industries.
(4 marks)

(c) As an Industrial Engineer at Delta Company, you are required to design the computer workstation for office employees which includes monitor, table, chair, keyboard, and mouse. Using appropriate sketches, suggest the concepts of ergonomic computer workstation.
(12 marks)

SECTION B
Answer only FOUR (4) from FIVE (5) questions provided.

Q2 (a) State **TWO (2)** quantitative methods that can be used in selecting facility location with cost effective.

(2 marks)

(b) Differentiate **TWO (2)** characteristics between product layout and process layout. Support your answer with a proper layout illustrations.

(6 marks)

(c) **Table Q2** shows the tasks necessary to assemble a hospital bed, the length of time needed to perform each task, and the operations that must be completed prior to subsequent operations.

Table Q2: Hospital bed assembly process

Task	Time (minute)	Precedence
A	None	4
B	None	5
C	None	8
D	A	4
E	A,B	3
F	B	3
G	D,E	5
H	F	7
I	G,H	1
J	I	7
K	C,J	4

(i) Draw a precedence diagram of production line.

(3 marks)

(ii) If the cycle time is 14 minutes, propose the minimum number of workstation.

(6 marks)

(iii) Propose the quantity of beds that can be assembled in eight-hour period.

(3 marks)

Q3 (a) Work sampling is one of the common methods used to calculate and study the capacity and productivity of an assembly line. **Table Q3(a)** shows the data collected during a work sampling study at a children furniture final assembly line. The work sampling was conducted for a total of 4 days. Each day, the plant was operating for 8 working hours and overall a total of 192 observations were conducted over the period of 4 days. The factory is currently employing 34 workers with the average monthly salary of RM 1250 per person. The management is looking forward to reduce the number of workers by using industrial engineering concept. Evaluate the given information and propose a suitable standard time for the final assembly process.

(5 marks)

Table Q3(a): Work sampling data

Item	Data
Production in progress	168 observations
Production is stopped due to various reasons	24 observations
Total output over 4 days study	1850 units
Factory rating during the study	90%
Time study allowance	15%

(b) **Table Q3(b)** shows the process sequence in the production line and its related direct time study data for a factory focusing on assembly of portable air conditioner. The process sequence needs to follow the specific route of A, B, C and D. The worker at task A was rated with 105%, the worker at task B was rated with 90% and the worker at task C was rated with 85%. Task D run in full automatic mode. The standard allowances accepted by the company are 5% for fatigue, 6% for personal, and 3% for delay. The normal operating period is 9 hours per day and 20 days per month. Analyse the given information and determine the standard time for the product.

(7 marks)

Table Q3(b): Average Processing Time (minute)

Task	Processing Time
A	28
B	45
C	27
D	15

(c) The assembly of multiple level wooden book shelves is done purely using manual assembly process. The standard time for the product is 42 min per unit. The company is currently employing 11 workers and having a working period of 9 hours per day with 20 days per month. The company is planning to produce 3100 units of output per month. The arrangement of overtime in the company is limited to only 15 days per month. Evaluate the situation and propose the number of operators that must be arranged to perform the overtime work daily in order to meet the production output. The overtime is executed 3 hours every day over the 15 days period.

(8 marks)

Q4 (a) Based on inventory management context, describe the difference in the use of 'Economic Order Quantity' and 'Production Order Quantity' models in more suitable situations.

(3 marks)

(b) A Process Engineer needs to schedule ten sequence jobs of two serial processes at Electrical & Mechanical Workshop. The processing time of each job is summarized in **Table Q4**.

Table Q4: Job processing time

Job	Process 1 (Days)	Process 2 (Days)
A	10	4
B	6	8
C	3	2
D	6	5
E	5	9
F	6	6
G	7	6
H	2	8
I	6	1
J	3	5

(i) Analyze the sequence job scheduling based on Johnson's Rule.

(3 marks)

(ii) For monitoring purpose, propose the schedule plan, idle time and makespan.

(6 marks)

(c) A pharmacist is required to prepare a budget for the purchase of insulin injection needle in a government hospital. The hospital has 50 diabetic patients daily and each patient needs two times insulin injections. Ordering cost is RM10 and the holding cost is RM 0.10 per unit needle per year. The delivery time from supplier are five days and the hospital operates 365 days a year.

(i) Propose the 'Order Quantity' and 'Number of Order' (per year) for the insulin injection needle.

(4 marks)

(ii) Based on result in **Q4(c)(i)**, compute the annual inventory cost.

(4 marks)

Q5 (a) Compare **TWO (2)** Garvin's quality dimensions between product and service. Support your comparison with suitable examples.

(4 marks)

(b) (i) Plot $\overline{X}$ control chart using data in **Table Q5(b)(i)**. Use a suitable factor in **Table Q5(b)(ii)** to compute the control chart limits. Given that $\sum R = 0.055$ mm.

(12 marks)

(ii) Based on **Q5(b)(ii)**, evaluate whether the process is in statistical control. Justify your answer.

(4 marks)

Table Q5(b)(i): Silicon Wafer Thickness

Subgroup Number	Measurements (mm)			
	X_1	X_2	X_3	X_4
1	0.2500	0.2510	0.2490	0.2500
2	0.2510	0.2490	0.2490	0.2520
3	0.2510	0.2490	0.2510	0.2480
4	0.2490	0.2470	0.2520	0.2480
5	0.2500	0.2470	0.2500	0.2520
6	0.2510	0.2520	0.2490	0.2510
7	0.2510	0.2480	0.2500	0.2500
8	0.2500	0.2490	0.2490	0.2520
9	0.2500	0.2470	0.2500	0.2510
10	0.2480	0.2480	0.2510	0.2530
11	0.2500	0.2500	0.2500	0.2530
12	0.2510	0.2490	0.2510	0.2540
13	0.2500	0.2470	0.2500	0.2510
14	0.2500	0.2500	0.2490	0.2520
15	0.2500	0.2470	0.2500	0.2510

Table Q5(b)(ii): Factors for Calculating $\overline{X}$ Control Chart

Size of sample (n)	Factor for UCL and LCL for $\overline{X}$ -chart (A_2)
2	1.880
3	1.023
4	0.729
5	0.577
6	0.483
7	0.419
8	0.373
9	0.337
10	0.308

Q6 (a) Describe **TWO (2)** advantages and disadvantages of Just-In-Time, which utilizes the Pull System

(4 marks)

(b) A firm that produces wood shutters and bookcases has received two orders for shutters: one for 100 shutters and one for 150 shutters. The 100-unit order is due for delivery at the start of week 4 of the current schedule, and the 150-unit order is due for delivery at the start of week 8. Each shutter consists of two frames and four slatted wood sections. The wood sections are made by the firm and the fabrication takes one week. The frames are ordered and lead time is two weeks. Assembly of the shutters requires one week. There is a scheduled receipt of 70 wood sections in (i.e., at the beginning of) week1.

(i) Schedule a master production scheduling and product structure tree

(4 marks)

(ii) Based on L4L ordering (i.e., order size equal to net requirements), propose the material requirement plan for shutters, frames and slatted wood.

(6 marks)

(iii) Based on FOQ ordering (i.e., a lot size of 320 units for frames and 70 units for wood sections), propose the material requirement plan for shutters, frames and slatted wood.

(6 marks)

- END OF QUESTION -

FINAL EXAMINATION

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EQUATIONS

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

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

Utilization = Total jobs processing time / sum of total flow time

Average number of jobs in the system = Sum of flow time/ Total processing time

$$UCL_R = D_4\overline{R} \qquad LCL_R = D_3\overline{R}$$

$$\mathrm{CL}_{\bar{x}} = \bar{\bar{x}} \pm A_2\,\overline{R} \qquad \bar{\bar{X}} = \frac{\sum \bar{X}}{g}$$

$$StdTime = \frac{TotalNormalTime}{1 - Allowance} \qquad \overline{R} = \frac{\sum R}{g}$$

$$NormalTime = Average\ cycle\ Time \times Rating$$

Standard Time, ST

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

$$\text{TM} = \frac{\sum t}{c} \quad \text{Idle time} = nc - \sum t \quad \text{Efficiency} = \frac{\sum t}{nc}(100)$$