Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	INDUSTRIAL ENGINEERING
COURSE CODE	:	BDA 40703
PROGRAMME	:	4 BDD
EXAMINATION DATE	:	DECEMBER 2018 / JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	PLEASE ANSWER **ALL** QUESTIONS **IN SECTION A** AND **FOUR (4)** QUESTIONS **IN SECTION B** FROM FIVE (5) QUESTIONS PROVIDED

THIS PAPER CONSISTS OF **NINE (9)** PAGES

SECTION A
Answer all questions in this section.

Q1 (a) Any external event in a natural physical environment that causes an individual stress or anxiety is known as an environmental stressor. It can be a force caused by nature or humans and can be done without intent. Those affected by these stressors don't necessarily change their routines, but their behavior can be severely altered.

(i) Name and explain at least **THREE (3)** physical environmental stressors in the workplace.

(6 marks)

(ii) There are many ways to control stress at work, including environmental stressors. As a business owner or manager, how you can ensure that each worker could perform their jobs comfortably and properly? Solve this issue by at least **THREE (3)** ways to control these.

(6 marks)

(b) Industrial engineering is a branch of engineering which deals with the optimization of complex processes, systems, or organizations. Industrial engineers work to eliminate waste of time, money, materials, person-hours, machine time, energy and other resources that do not generate value. According to the Institute of Industrial and Systems Engineers, they create engineering processes and systems that improve quality and productivity. Explain how industrial engineers involved in these following fields:

(i) Quality engineering

(2 marks)

(ii) Operations management

(2 marks)

(c) Malaysia's most anticipated new tourism development, Desaru Coast, is the premium integrated destination presented its latest developments and various offerings in the hidden gem of Johor. Developed by Desaru Development Holdings One Sdn.Bhd., Desaru Coast is located at the south-eastern region of Malaysia, spanning over 3,900 acres along an unspoiled 17km beachfront facing the South China Sea. The destination is easily accessible via land, ferry, and air. Desaru Coast is home to four globally renowned hotels and resorts, two world-class golf courses, a themed water park, a retail village as well as a conference centre. With this massive development, discuss how industrial engineers could contribute in the operation of this facilities.

(4 marks)

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

Q2 (a) A proper plan for layout design is crucial in facilities planning. Propose the general schematic diagrams for product layout and process layout.

(5 marks)

(b) BMW Motors is considering three sites to locate a new factory to build its new-model automobile, BMW i8 Roadster. The goal is to select location at minimum cost, measured by annual fixed plus variables of production. This company has gathered the data as shown in **Table Q2(b)**.

Table Q2(b): Annual fixed and variable costs

Site	Annual Fixed Cost	Variable Cost Per Auto Produced
A	$10,000,000	$2500.00
B	$20,000,000	$2000.00
C	$25,000,000	$1000.00

(i) Propose the numerical and graphical break-even point for each site

(8 marks)

(ii) Based on finding in **Q2(b)(i)**, predict the volume of BMWs indicates site A and site C are optimal.

(4 marks)

(iii) Based on finding in **Q2(b)(i)**, justify over what range of volume considered site B is optimal

(3 marks)

Q3 (a) In a recent work sampling study at an assembly plant, 6 days was allocated for the overall exercise. Each day, the plant was operating for 8 hours. The data collected during the 6 days study is illustrated in **Table Q3(a)**. The factory is employing 25 workers with an average salary of RM 65 per day per worker. Evaluate the available data and propose a suitable standard time in minutes for a unit of product covering the assembly process.

(5 marks)

Table Q3(a): Work sampling data

Item	**Data**
Production in progress	216 observations
Production is stopped due to various reasons	24 observations
Total output over 6 days study	3260 units
Factory rating during the study	93%
Time study allowance	17%

(b) The production process in an aerospace component manufacturing must follow a specific route of processes A, B, C, and D respectively. Task C is in full automatic mode and requires one operator at the workstation. The worker at task A was rated with 110%, the worker at task B was rated with 88% and the worker at task D was rated with 80%. The acceptable time allowances by the company are 6% for fatigue, 5% for personal and 4% for delay. The normal operating hours is 8 hours per day and 24 days per month. **Table Q3(b)** shows the process sequence in a production line and its related direct time study data.

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

Task	Description	Processing Time
A	Manual	43
B	Manual	64
C	Automatic	23
D	Manual	37

(i) Analyse the given information and determine the standard time for the product.

(7 marks)

(ii) If the company decided to produce 490 units per month, suggest the number of operators required for the overall process.

(4 marks)

(iii) The company is currently allowing only 3 hours overtime per day and also has limited the overtime arrangement to only 11 days per month. At the same time, the company has decided to employ only 7 operators and cover the shortage capacity using overtime. 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 of 490 units per month. Assume the overtime is executed 3 hours every day over the 11 days period.

(4 marks)

Q4 (a) List down **THREE (3)** benefits of inventory.

(3 marks)

(b) In MSS machine shop specialist, five engine blocks are waiting for re-bore processing as recorded in **Table Q4**. The company has only one engine expert in diagnosing engine problems, estimating processing times and negotiating with customers.

Table Q4: Task and work center

Engine block	Processing time (hours)	Due date (hours)
A	8	10
B	6	12
C	15	20
D	3	18
E	12	22

(i) Arrange the schedule for the engine expert by using the EDD rule and the SPT rule.

(5 marks)

(ii) Based on average hours past due analysis, propose the sequence rule should be chosen.

(3 marks)

(c) SPEEDO Engineering manufactures various models of bicycle for Southeast Asia market. They produces 450 units of model A bicycles per month. The tires for this model are purchased from main supplier at a price of RM20 per unit. The company estimates their inventory carrying cost to be 15% of the supplied tires, whereas the ordering cost is RM50 per order.

(i) Determine the EOQ and the number of order

(6 marks)

(ii) How much annual cost should be allocated for inventory management?

(3 marks)

Q5 **Table Q5** shows the width of circuit board manufactured in NEMIC-λ company.

(a) Solve the average and range for subgroup 23, 24 and 25. Use three decimal points.

(3 marks)

(b) Determine upper and lower control limits for $\overline{X}$ chart and R chart. Use the information in **Table Q5(b)** to compute the control limits.

(8 marks)

(c) Construct $\overline{X}$ and R control charts.

(7 marks)

(d) Based on control charts **Q5(c)**, evaluate whether the process is in control. Justify your answer.

(2 marks)

Table Q5: Circuit board width

Subgroup Number	Lengths					Average $\overline{X}$	Range R
	X_1	X_2	X_3	X_4	X_5		
1						5.010	0.038
2						5.001	0.019
3						5.008	0.036
4						5.003	0.022
5						5.003	0.026
6						4.996	0.024
7						5.000	0.012
8						4.997	0.030
9						5.005	0.014
10						4.998	0.017
11						4.994	0.008
12						5.001	0.011
13						4.998	0.029
14						4.990	0.039
15						5.006	0.016
16						4.997	0.021
17						5.001	0.026
18						5.007	0.018
19						4.998	0.021
20						5.009	0.020
21						5.000	0.021
22						5.002	0.019
23	5.010	4.989	4.990	5.009	5.014		
24	5.015	5.008	4.993	5.000	5.010		
25	4.982	4.984	4.995	5.017	5.013		

Table Q5(b): Factors for control charting

Size of sample (n)	Factor for UCL and LCL for $\overline{X}$ -charts (A_2)	Factor for LCL for R-charts (D_3)	Factor for UCL for R-charts (D_4)
2	1.880	0	3.267
3	1.023	0	2.574
4	0.729	0	2.282
5	0.577	0	2.114
6	0.483	0	2.004
7	0.419	0.076	1.924
8	0.373	0.136	1.864
9	0.337	0.184	1.816
10	0.308	0.223	1.777

Q6 (a) List **THREE (3)** supporting goals of Lean System and illustrate its goals and building blocks.

(5 marks)

(b) The product tree structure in **Figure Q6** 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 unit in week 8. Inventory records are shown in **Table Q6**.

(i) Compute the lead time to produce product A

(3 marks)

(ii) Propose the material requirement planning for each item / component

(12 marks)

Table Q6: Inventory record

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

- END OF QUESTION -

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FIGURE

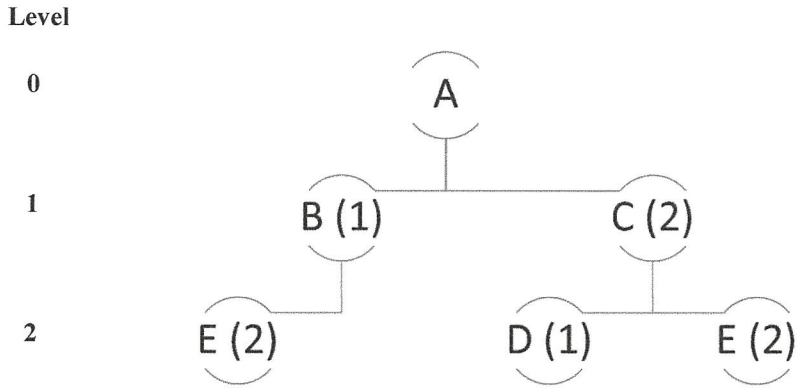

Figure Q6: Product tree structure

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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

$$UCL_R = D_4\bar{R} \qquad \mathrm{CL}_{\bar{x}} = \bar{\bar{x}} \pm A_2\bar{R} \qquad \bar{\bar{X}} = \frac{\sum \bar{X}}{g}$$

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

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

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

Standard Time, ST

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

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