Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	INDUSTRIAL ENGINEERING
COURSE CODE	:	BDA 40703
PROGRAMME	:	4 BDD
EXAMINATION DATE	:	JUNE / JULY 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) Give a definition of ergonomics study.

(2 marks)

(b) Boundaries for ergonomics involve work environment, phychosocial environment and physical environment. Briefly explain **TWO (2)** examples of each environment.

(6 marks)

(c) Cumulative trauma disorders (CTDs) are injuries of the musculoskeletal and nervous systems. Name and explain **THREE (3)** causes of CTDs.

(6 marks)

(d) Industrial engineers figure out how to do things better. Explain how industrial engineers involved in these following industries:

(i) Manufacturing

(2 marks)

(ii) Logistic

(2 marks)

(iii) Service

(2 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. Discuss a schematic diagram and example of fixed position layout design.

(4 marks)

(b) Using a suitable example or schematic diagram, compare **TWO (2)** methods to improve production layout using work cell.

(4 marks)

(c) A factory engineer is assigned to setup a production line to meet increased demand. The production line data are summarized in **Table Q2**.

Table Q2: Production line data

Task	Performance Time (minute)	Immediate Predecessors
A	12	None
B	13	A
C	10	A
D	12	B
E	10	B
F	11	B
G	15	C
H	13	D, E, F
I	22	G
J	20	H, I

(i) Sketch the precedence diagram of production line.

(3 marks)

(ii) In production line, the cycle time was estimated at 25 minutes per unit. If tasks A and J cannot be grouped with other tasks, propose the minimum number of workstation.

(5 marks)

(iii) The effective operations time are 6 hours per day and 5 days per week. Evaluate the weekly capacity of production line.

(4 marks)

Q3 (a) A work sampling study was conducted at a bicycle assembly plant for 5 days. Each day, the plant was operating for 9 working hours. Overall 200 observations were conducted and the data collected during the study is illustrated in **Table Q3(a)**. The factory is currently expecting a RM10 million export market and the top management is planning to increase the factory capacity. Determine a suitable standard time for the assembly process.

(5 marks)

Table Q3(a): Work sampling data

Item	**Data**
Production in progress	92% observations
Production is stopped due to various reasons	8% observations
Total output over 5 days study	2250 units
Factory rating during the study	87%
Time study allowance	18%

(b) Processes A, B, C and D have been identified as the key processes to produce a new product for Power Tower Sdn Bhd. It has been confirmed that the process sequence has to follow the specific route of A, B, C and D. Task A is in full automatic mode and requires one operator at the workstation. The worker at task B was rated with 90%, the worker at task C was rated with 115% and the worker at task D was rated with 80%. The standard allowances accepted by the company are 6% for fatigue, 5% for personal, and 4% for delay. The normal operating period is 8 hours per day and 24 days per month. **Table Q3(b)** shows the process sequence in the production line and its related direct time study data. Determine the standard time for the product.

(7 marks)

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

Task	Description	Processing Time
A	Automatic	22
B	Manual	42
C	Manual	29
D	Manual	37

(c) A company involved with purely manual assembly process is planning to produce 720 units of output per month. The standard time for the product is 115 min per unit. The company is currently employing 6 workers and having a working period of 8 hours per day with 24 days per month. 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 24 days period.

(8 marks)

Q4 (a) Compare the difference between 'Loading' and 'Sequencing'.

(2 marks)

(b) Five jobs are waiting to be assigned at MP Manufacturing Sdn Bhd. **Table Q4** shows the scheduling data which involves the jobs (in the order they arrived), processing time, and due date for the job.

Table Q4: Scheduling data

Job	Processing time (Days)	Due date (Days)
A	6	8
B	2	6
C	8	18
D	3	15
E	9	23

(i) Analyse the schedules using First Come First Served (FCFS), Earliest Due Date (EDD), and Shortest Processing Time (SPT) rules.

(9 marks)

(ii) Based on schedules in **Q4(b)(i)**, justify the most appropriate sequencing rules if 'Delivery Time' is the main criteria.

(3 marks)

(c) Regency Hotel has 1000 rooms to be offered to the customers. Daily demand for the bar soaps at the hotel are two units for each room. Ordering cost is RM5 and the holding cost is RM 0.70 per unit per year. The delivery times from supplier are five days. The hotel operates 365 days every year.

(i) Propose the Economic Order Quantity (EOQ) for the bar soaps.

(3 marks)

(ii) Based on EOQ obtained in **Q4(c)(i)**, estimate the optimal total annual inventory cost.

(3 marks)

Q5 (a) Six Sigma is one of effective technique in quality control. Define the objective and elements involved in the Six Sigma model.

(4 marks)

(b) Using a suitable example or diagram, suggest **TWO (2)** statistical process control tools that can be used to analyze root cause error.

(4 marks)

(c) The diameter of metal screw is a critical-to-quality variable. Observation data as summarized in **Table Q5(a)** are used to monitor this variable using $\overline{X}$ - R charts.

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

(6 marks)

(ii) Construct $\overline{X}$ - R control charts.

(4 marks)

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

(2 marks)

Table Q5(a): Observations of screw diameter

Subgroup Number	Samples (mm)			
	X_1	X_2	X_3	X_4
1	2.5014	2.5022	2.5009	2.5027
2	2.5021	2.5041	2.5024	2.5020
3	2.5018	2.5026	2.5035	2.5023
4	2.5008	2.5034	2.5024	2.5015
5	2.5041	2.5056	2.5034	2.5047

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

Q6 (a) State **SEVEN (7)** types of waste.

(7 marks)

(b) Product assembly of digital watch (DW) is planned for the next two months. Bill of materials and Master Production Schedule for DW are shown in **Figure Q6** and **Table Q6(a)**. The inventory data for all items are summarised in **Table Q6(b)**. Schedule the material requirements planning (MRP) for items C, D, F and G.

(13 marks)

Table Q6(a): Master production schedule

Week	5	6	7	8
Quantity	90	120	130	115

Table Q6(b): Inventory data

Item	Lot-sizing rule	Lead time (week)	On-hand inventory
A	FOQ = 50	2	30
B	POQ (P=2)	1	30
C	L4L	2	44
D	FOQ = 70	1	35
E	FOQ = 50	2	11
F	POQ (P=2)	2	300
G	POQ (P=3)	1	170
H	FOQ=300	2	150

- **END OF QUESTION** -

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FIGURE

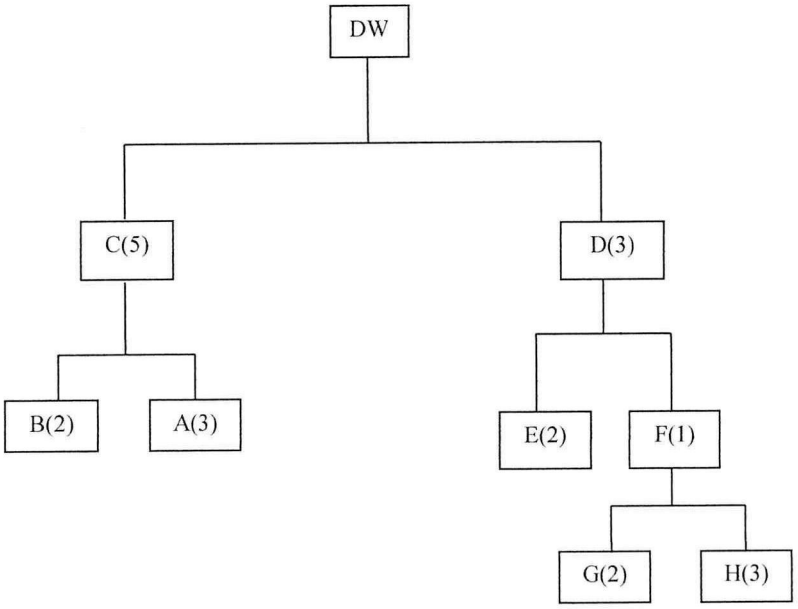

Figure Q6: Product tree structure

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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

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

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

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

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

Standard Time, ST

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

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