



# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION SEMESTER I SESSION 2010/2011

COURSE NAME : INDUSTRIAL ENGINEERING  
COURSE CODE : BDA 4012  
PROGRAMME : 4 BDD  
EXAMINATION DATE : NOVEMBER/DECEMBER 2010  
DURATION : 2 HOURS 30 MINUTES  
INSTRUCTION : ANSWER FOUR (4) QUESTIONS  
ONLY FROM FIVE (5) QUESTIONS

THIS PAPER CONTAINS SIX (6) PAGES

- Q1** (a) TQM implementation has the purposes to provide quality product to customers, to increase productivity and reduce cost. In achieving these purposes, TQM give high priority to the concept of employee involvement. Briefly explain the concept of employee involvement in TQM. (5 marks)
- (b) Briefly explain the usage of the following basic Quality Control tools: (6 marks)
- (i) Ishikawa Diagram
  - (ii) Scatter diagram
  - (iii) Pareto Diagram
- (c) Plastico Ltd is a company that produces plastic container located in Melaka. Table 1 shows the average and range in mililitres for volume tests conducted on the plastic container products. The sample size for each subgroup is 4. (12 marks)
- (i) Determine upper and lower control limits for  $\bar{X}$ -chart and R-chart. Use the factors in Table 2 to compute the control chart limits. (12 marks)
  - (ii) Is the process in control? Explain your answer. (2 marks)

Table 1: The average and range in mililitres for volume tests

Subgroup Number	X-bar	R	Subgroup Number	X-bar	R
1	485	29	14	482	26
2	490	25	15	498	25
3	464	22	16	464	24
4	469	27	17	484	24
5	474	22	18	476	32
6	482	22	19	466	24
7	500	23	20	484	42
8	496	23	21	466	26
9	478	25	22	470	24
10	484	24	23	494	24
11	500	23	24	486	28
12	476	25	25	496	23
13	488	24			

Table 2: Factors for Calculating  $\bar{X}$  and R Control Charts

Size of sample (n)	Factor for UCL and LCL for $\bar{X}$ -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	2.575
4	0.729	0	2.282
5	0.577	0	2.115
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

**Q2** (a) Briefly explain the followings:

(i) What is fixed-position layout?

(3 marks)

(ii) Why fixed-position layout is preferred in certain industries?

(3 marks)

(b) Assign trucks to delivery route so that total costs are minimized, given the cost data shown on Table 3. What is the total cost of the solution found?

(9 marks)

Table 3: Cost data for each truck to each route in Ringgit

TRUCK	ROUTE						
	A	B	C	D	E	F	G
1	10	12	13	11	10	6	16
2	5	6	4	8	4	9	6
3	32	40	31	30	42	35	36
4	17	14	19	15	10	16	19
5	6	7	10	5	8	10	11
6	8	10	12	8	9	10	9

- (c) A company that produces pleasure boats has decided to expand one of its lines. Current facilities are insufficient to handle the increased workload. The company is considering three alternatives, A (new location), B (subcontract), and C (expand existing facilities).

*Alternative A* would involve substantial fixed costs but relatively low variable costs: fixed costs would be RM250,000 per year, and variable costs would be RM500 per boat. *Alternative B* would involve a cost per boat of RM2,500, and *alternative C* would require an annual fixed cost of RM50,000 and a variable cost of RM1,000 per boat.

- (i) Find the range of output (unit boat) for each alternative that would yield the lowest total cost. (7 marks)
- (ii) Which alternative would yield the lowest total cost for an expected annual volume of 150 boats? (3 marks)

- Q3** (a) In today's competitive business world, product with less ergonomic features is most likely cannot be successfully marketed. Briefly describe the general functions of ergonomic features in product? (5 marks)

- (b) An industrial engineer is requested to determine a standard time for the door assembling of a Proton car (4 door type). This activity is conducted by four operators at door assembling line. Two operators assemble the left doors (front door and back door, respectively) and the other two operators assemble the right doors (front door and back door, respectively) of the car. Assume that the doors are assembled at once (simultaneously) by these four operators. The following data on Table 4 is collected for assembling just one door.

Table 4: Time Study Data for the Door of Proton Car

Task	Observation (in seconds)					Performance Ratings
	1	2	3	4	5	
A	15	16	14	15	16	110%
B	12	13	13	13	12	110%
C	23	22	22	22	24	105%
D	24	25	25	24	24	105%

Allowance factor for doing these tasks (A until D) is 12%.

- (i) Determine the standard time for assembling one door of Proton car above.
- (ii) How many cars (Proton) can be processed at the door assembling line in a month? Assume that there are 26 days in a month (2 shifts a day, and each shift is 8 hours).

- (iii) How much cost should be paid to one operator if labor cost for door assembling per - one unit car is RM 1? Assume this operator works just in one shift.
- (iv) During peak season the demand is 49,465 unit cars per month, estimate the number of operators required for the assembly process. Assume each operator is allowed to work in one shift only.
- (v) If the company can only manage to employ 20 workers, compute the over time cost per day for each worker for the production of 49,465 units of car per month. Assume only 8 workers are available for over time and the over time pay rate is 1.5 times of the normal wage.

(20 marks)

- Q4** (a). The actual sale of a product during the last 6 months is given in the Table 5. Estimate the sales forecast for month of July using exponential smoothing method with  $\alpha$  value as 0.10 and 0.30. Give your justification which value of  $\alpha$  is more suitable. The forecast for the month January shall be taken as 12.5 units.

(13 marks)

Table 5: Sales Data

Months	Actual sales x 1000
January	11
February	14
March	16
April	10
May	15
June	17

- (b) A company is engaged in casting of carburetors. Its demand from the automobile industries per year is 50,000 units. The cost of set up is RM 100. There are ten workers engaged, each on wage rate of RM 15 per hour. The overhead cost is RM 100 per day. The daily production capacity is 200 units for an 8 hour working period. The material cost per each carburetor is RM 15. The annual rate of depreciation, insurance, taxes and storage cost is 20 % of unit cost. No shortages are permitted and supplied in one lot.

Find the following:

- (i) Economic lot size.  
(ii) The number of runs.  
(iii) Duration of each run.

(12 marks)

- Q5** (a) The manager of Barbecued Lambs wants to organize the task involved in the preparation and delivery of the company's product. The manager plans to produce 60 lambs per 10-hour workdays. Table 5 presents work element times and precedence relationships.
- (i) Construct a precedence diagram for this process. (3 marks)
- (ii) Compute the cycle time. (2 mark)
- (iii) Determine the theoretical minimum number of workstations. (1 mark)
- (iv) Using the largest work element-time rule, assign tasks to the workstations in order to have appropriate line balancing. (5 marks)
- (v) What are the efficiency and balance delay of the solution found? (2 marks)

Table 5: Delivery of lambs task information

Task	Time Required (minute)	Immediate Predecessors
A	3	None
B	5	A
C	2	B
D	7	B
E	7	C, D
F	6	E
G	2	D, E
H	3	F
I	8	G
J	6	H
K	3	I, J
L	8	K

- (b) Use Johnson's rule to find the optimum sequence and its makespan (completion time for the last job) for the two work centers problem shown in Table 6.

Table 6: Processing time (hours)

Job	Work center 1	Work center 2
A	6	12
B	3	7
C	18	9
D	15	14
E	16	8
F	10	15

(12 marks)