UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2010/2011

COURSE NAME	:	**INDUSTRIAL ENGINEERING**
COURSE CODE	:	**BDA 4012**
PROGRAM	:	**BACHELOR OF MECHANICAL ENGINEERING WITH HONOURS**
EXAMINATION DATE	:	**APRIL / MAY 2011**
DURATION	:	**2 HOURS 30 MINUTES**
INSTRUCTION	:	**ANSWER FOUR (4) QUESTIONS ONLY FROM FIVE (5) QUESTIONS**

THIS PAPER CONTAINS OF SEVEN (7) PAGES

Q1 (a) A major manufacturing company has several production facilities scattered around the central and northern part of Malaysia. It would be desirable to have a central warehouse from which the products will be collected and sent to big retailers which are located at cities A, B, C, D, and E. Using the data in Table 1 and minisum method, determine the ideal location for the desired distribution centre and compute the total travelling distance.

(12 marks)

Table 1: The cities-coordinates of production facilities

Cities	Coordinate (x, y)	Total number of trips per month
A	(2,12)	20
B	(7,10)	19
C	(4,1)	12
D	(5,17)	22
E	(8,4)	5

(b) A company owner is considering to construct a new factory either in city C or city D in order to supplement the ones he already has (existing factories) in city A and city B. The existing factories and the new factory (total of three factories) must serve five existing warehouses as shown in Table 2. Using transportation method, determine the best location for the new factory so that the minimum total cost can be achieved?

(13 marks)

Table 2: Total cost (production + distribution) in RM per unit from plants to each warehouse

From \ To		Warehouse					Capacity
		V	W	X	Y	Z	
Plant	A (existing)	15	5	6	3	8	15,000
	B (existing)	2	7	4	10	5	15,000
	C	3	6	7	8	9	10,000
	D	3	4	9	5	10	10,000
	Demand	5,000	7,000	13,000	8,000	7,000	

Q2 (a) A set of data for a time study conducted at an assembly factory is shown in Table 3. The normal working time for the factory is 20 days per month with one 8 hour-shift per day.

(i) Determine the overall standard time for assembling one product.

(6 marks)

(ii) Compute the number of operators required by the factory if the total demand is 10,000 units per month.

(4 marks)

(iii) If the factory has only 85 operators, compute the overtime per day needed to be arranged for each operator. Assume that the overtime can only be done by 50 operators for a total of 15 days per month.

(5 marks)

Table 3: The time data for each task of an assembly process

Task	Observation (in minutes)					Performance Ratings	Allowance Factor
	1	2	3	4	5		
A	35	37	38	36	34	90%	7%
B	12	13	13	13	12	105%	4%
C	23	22	22	22	24	110%	5%
D	24	25	26	24	24	80%	6%

(b) The distance to relocate three (3) different machines to several locations is shown in Table 4. Using *assignment technique*, calculate the optimum total relocation distance.

(10 marks)

Table 4: Relocation distance to new locations

	Location A	**Location B**	**Location C**	**Location D**
Machine X	80	110	120	110
Machine Y	50	160	80	80
Machine Z	50	100	230	150

Q3 (a) Figure Q3 shows the product structure and quantities of each component needed to assemble for product A. Using MRP table, data in Table 5 and Table 6, determine the order release date and quantity required for component B and component D and component E.

(15 marks)

Table 5: Data for Lead Time, Quantity on Hand and Ordering Rules

Item	Lead Time (week)	Quantity On Hand (unit)	Rules
A	1	10	Lot for Lot
B	1	20	FOQ (50)
C	3	100	
D	1	100	POQ (P=3)
E	1	500	Lot for Lot, safety stock=75. Schedule Receipts = 1,000 units at week 3
F	1	10	

Table 6: Gross requirement for component A

Period (week)	4	5	6	7	8	9	10	11
Gross requirement (units)				75		170		120

(b) Briefly describe FIVE (5) steps to control or to reduce noise effects to worker.

(4 marks)

(c) Briefly explain the usage of the following basic Quality Control tools:

(i) Cause and Effect Diagram.
(ii) Scatter Diagram.
(iii) Flowchart.

(6 marks)

Q4 (a) Computer upgrades have a nominal time of 80 minutes. Samples of five observations each have been taken, and the results are listed in Table 7. Determine upper and lower control limits for $\overline{X}$-chart and R-chart, and decide if the process is in control. Use the factors in Table 8 to compute the control chart limits.

(15 marks)

Table 7: Sample of computer upgrades in minutes

SAMPLE					
1	2	3	4	5	6
79.2	80.5	79.6	78.9	80.5	79.7
78.8	78.7	79.6	79.4	79.6	80.6
80.0	81.0	80.4	79.7	80.4	80.5
78.4	80.4	80.3	79.4	80.8	80.0
81.0	80.1	80.8	80.6	78.8	81.1

Table 8: Factors for Calculating $\overline{X}$ and R Control Charts

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	2.575
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

(b) As you can see in Table 9, demand for heart transplant surgery at Batu Pahat General Hospital has increased steadily in the past few years. The director of medical services predicted 6 years ago that the demand in year 1 would be 41 surgeries

(i) Use exponential smoothing, first with a smoothing constant of 0.6 and then with one of 0.9, to develop forecasts for years 2 through 6.

(4 marks)

(ii) Use the trend projection method to forecast the demand in year 6 and year 7.

$$m = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - \left(\sum x\right)^2} \qquad c = \frac{\sum y - m\sum x}{n}$$

(6 marks)

Table 9: Demand for heart transplant surgery

Year	1	2	3	4	5
Heart transplant	45	50	52	56	58

Q5 (a) Ergonomics is one of the topics discussed in industrial engineering subject.

(i) Briefly explain what ergonomics is and how can it help to improve the working environment in manufacturing industries?

(4 marks)

(ii) Give a definition of anthropometry data and explain the need for it.

(4 marks)

(b) A manufacturer of sails for small boats has a group of custom sails awaiting the last two processing operations before the sails are sent to the customers. Operation 1 must be performed before operation 2, and the jobs have different time requirements for each operation. The hours required are as shown in Table 10.

(i) Use Johnson's rule to determine the optimal sequence.

(4 marks)

(ii) Draw graphically the time-phased flow of each operation, and identify the completion time of job G at operation 2.

(4 marks)

Table 10: Different time (in hours) requirements of jobs for each operation

	Job									
	A	B	C	D	E	F	G	H	I	J
Operation 1	1	5	8	3	9	5	7	2	4	3
Operation 2	8	3	1	2	8	6	7	5	4	9

(c) A chemical firm produces sodium bisulfate in 100-pound bags. Demand for this product is 20 tons per day. Setup costs $100, and storage and handling costs are $5 per ton a year. The firm operates 200 days a year. (Note: 1 ton = 2,000 pounds)

(i) Determine the economic order quantity.

(2 marks)

(ii) What would the average inventory be for this lot size?

(1 marks)

(iii) Determine the approximate length of a production run, in days.

(1 marks)

(iv) If the normal lead time for each order is FIVE (5) working days, compute the average reorder point, in pound.

(1 marks)

(v) How much could the company save annually if the setup cost could be reduced to $25 per run?

(4 marks)

FINAL EXAMINATION

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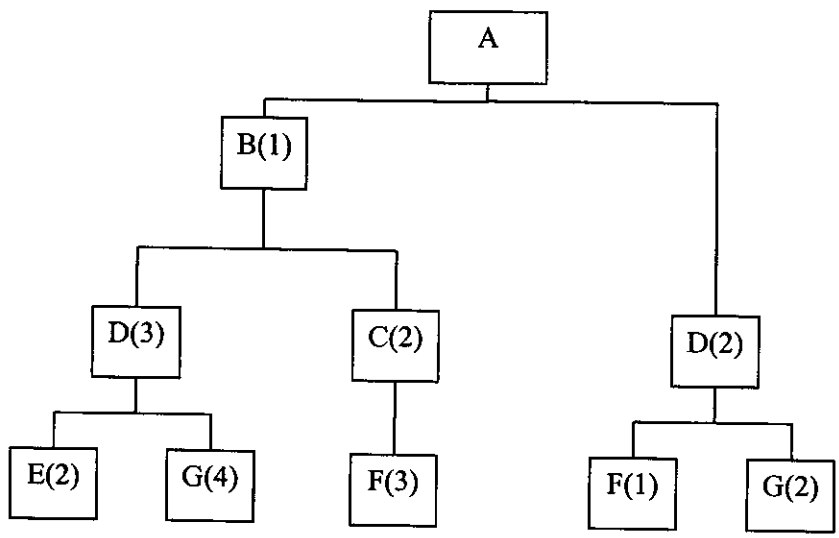

Figure Q3