UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2009/2010

SUBJECT NAME	:	INDUSTRIAL ENGINEERING
SUBJECT CODE	:	BDA 4012
COURSE	:	3 BDD, 4 BDD
EXAMINATION DATE	:	APRIL/MAY 2010
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY FROM **FIVE (5)** QUESTIONS

THIS PAPER CONTAINS OF EIGHT (8) PAGES

Q1 (a) The operation manager for a carbonated drinks packaging company has narrowed the search for a new facility location to seven communities. Annual fixed costs and variable costs are shown in Table 1.

(i) Which of the communities can be eliminated from further consideration because they are dominated by another community? (Hint: A community which has both variable and fixed costs higher than another community can be eliminated).

(2 marks)

(ii) Plot the total cost curves for the remaining communities on a single graph. Identify on the graph the approximate range over which each community provides the lowest cost.

(7 marks)

(iii) Using break-even analysis, calculate the break-even quantities to determine the range over which each community provides the lowest cost.

(6 marks)

Table 1: Fixed and variable costs data

Community	**Fixed costs per year ($)**	**Variable costs per carton ($)**
Aurora	210,000	7.20
Flora	200,000	7.00
Garden City	150,000	9.00
Greensboro	280,000	6.20
Roseland	260,000	6.00
Sunnyvale	420,000	5.00
Watertown	370,000	8.00

(b) The SpaQ Company has FOUR (4) factories that ship products to FIVE (5) warehouses. The shipping costs, requirements, and capacities are shown in Table 2. Use the transportation method to find the shipping schedule that minimizes the shipping cost. Compute the minimum total cost that can be achieved?

(10 marks)

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

From \ To		Warehouse					Capacity
		W1	W2	W3	W4	W5	
Factory	F1	1	3	3	5	6	50,000
	F2	2	2	1	4	5	80,000
	F3	1	5	1	3	1	80,000
	F4	5	2	4	5	4	40,000
	Demand	45,000	30,000	30,000	35,000	50,000	

Q2 (a) Five jobs are in a queue waiting to be released into a work center. These jobs, their required processing time, and their due dates are given in Table 3. They are listed in order of their arrival at the work center.

Table 3: Data for Processing Time and Due Date

Job	Required Time (days)	Due Date (days hence)
A	3	6
B	6	10
C	2	9
D	4	7
E	1	2

Determine the proper job sequence using SPT and DDATE rules. For each solution, compute average flow time, average tardiness, utilization, and average number of jobs in the work center.

(10 marks)

(b) Given the operation time provided in Table 4:

Table 4: Work Stations Assignment for the Job

Place	Job Time (minutes)				
	a	**b**	**c**	**d**	**e**
Work Station A	25	18	70	26	15
Work Station B	45	33	24	30	10

(i) Find the sequence that will minimize total completion time. Illustrate graphically.

(3 marks)

(ii) Determine the amount of idle time for workstation B.

(2 marks)

(c) The flow diagram of an assembly process is shown in Figure Q2. The relevant data on scrap rate and processing time at each work centre is summarised in Table 5. The company uses the operation policy of 8 hours per day, 24 days per month and 12 months per year.

(i) If the average monthly demand for product A is 2,000 units per month, compute the quantity of input required per year at work centre C2.

(4 marks)

(ii) How many work centre A must be set up in order to meet the customer demand of 2,000 units per month?

(4 marks)

(iii) In specific weeks, the input available at work centre D3 is 2,100 units per day. Compute the expected daily output at work centre C3 during these specific weeks.

(2 marks)

Table 5: Work Centres Scrap Rate and Processing Time

Work centre	Scrap Rate	Processing Time (min/unit)	Work Centre	Scrap Rate	Processing Time (min/unit)
A	1.5%	13	C3	3.1%	5
B	2.0%	25	D1	4.0%	21
C1	2.3%	32	D2	5.5%	17
C2	1.7%	9	D3	6.2%	8

Q3 (a) Briefly explain what ergonomics is and how can it help to improve the working environment in manufacturing industries?

(5 marks)

(b) A work sampling study conducted at a metal coating plant has resulted to the data in Table 6. The plant operation time is 8 hours/day, 6 days/week, 4 weeks/month.

(i) Compute the standard time in min/unit for the coating process.

(3 marks)

(ii) If the total demand for the plant is 14,500 units per month, determine the overtime period per day that must be arranged to meet the customers demand. Only 70% employees are willing to work overtime and the overtime is arranged on every working day.

(7 marks)

Table 6: 6-Day Work Sampling Study Data

Item	Data
Total observation period	6 days
Observation time per day	8 hours
Plant in operations during 6-day study	270 observations
Plant idle during 6-day study	18 observations
Average daily output	520 units/day
Rating	90%
Allowances	15%

(c) The regular demand data for Mass Group Ltd. is shown in Table 7. The typical ordering cost or setup cost is RM550; holding cost is 20% of purchase price; purchase price is RM80 per unit; and the normal lead time for each order is FIVE (5) working days. The highest recorded daily demand rate is 800 units per day; the lowest recorded daily demand rate is 50 units per day; the working period is 8 hours per day, 25 days per month, and 12 months per year.

(i) Based on the above data, compute the economic order quantity to be ordered each time the company purchases its material.

(3 marks)

(ii) Calculate the optimum number of orders per year and the expected time between order need to be placed by the company.

(3 marks)

(iii) Compute the average reorder point (ROP)

(2 marks)

(iv) Compute the total inventory cost using the economic order quantity.

(2 marks)

Table 7: Regular Demand Data

Jan.	Feb.	March	Apr	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
8500	7000	9500	9500	8500	9000	8500	8000	9500	8500	8500	7000

Q4 (a) Briefly describe FIVE (5) steps to control or to reduce noise effects to worker.

(4 marks)

(b) Figure Q4 shows the product structure and quantities of each component needed to assemble a portable grinder called Alpha. Using data in Table 8 and Table 9, prepare MRP table for finished product Alpha, component B and component D.

(12 marks)

Table 8: Data for Lead Time, Quantity on Hand and Ordering Rules

Item	Lead Time (week)	Quantity On Hand (unit)	Rules
Alpha	1	10	Lot for Lot
B	2	20	FOQ (50)
C	3	0	
D	1	100	POQ (P=3), safety stock 50
E	1	10	
F	1	50	

Table 9: Customers Demand for Alpha

Period (week)	4	5	6	7	8	9	10	11
Customers Demand (units)				50		50		100

(c) The number of transistors (in millions) made at a plant in Japan during the last five years is shown in Table 10.

(i) Forecast the number of transistors to be made at year 6 using weighted moving average method. The weight factors are: 0.6 for last year, 0.3 for two years ago and 0.1 for three years ago.

(2 marks)

(ii) Using exponential smoothing method, forecast the number of transistors to be made at year 6 and 7. The forecast value for year 3 is 198 million units whereas the production quantity for year 6 equals 95% of the forecast value. Assume $\alpha = 0.25$.

(7 marks)

Table 10: Annual Production Quantity (million units)

Year	Transistors
1	140
2	160
3	190
4	200
5	210

Q5 (a) Briely explain the following terms:

(i) Quality control.
(ii) Quality assurance.

(5 marks)

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

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

(6 marks)

(c) A process that is considered to be in control measures an ingredient in grams. Table 11 shows the data for the last TEN (10) samples. For each sampling, size n = 5 is used.

(i) Determine upper and lower control limits for $\bar{X}$-chart and R-chart. Use the factors in Table 12 to compute the control chart limits.

(12 marks)

(ii) Is the process in control? Explain your answer, whether the process is in control or not!

(2 marks)

Table 11: Weight data for the last TEN (10) samples (grams)

SAMPLES									
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
10	9	13	10	12	10	10	13	8	10
9	9	9	10	10	10	11	10	8	12
10	11	10	11	9	8	10	8	12	9
9	11	10	10	11	12	8	10	12	8
12	10	9	10	10	9	9	8	9	12

Table 12: 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

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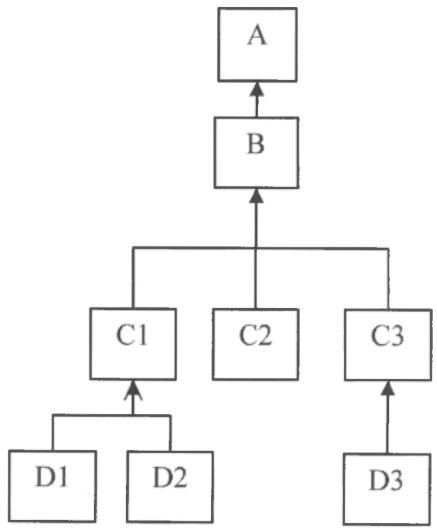

FIGURE Q2

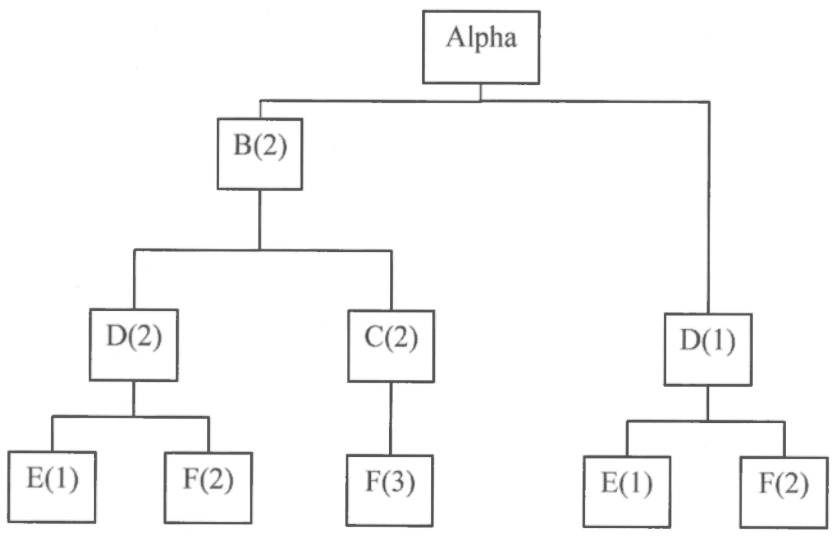

FIGURE Q4