UNIVERSITI SAINS MALAYSIA

2nd. Semester Examination
2002/2003 Academic Session

February / March 2004

JUM 211/3 – Operational Research

Duration : 3 hours

Instructions to candidates:

1. Ensure that this paper contains **FIVE (5)** printed pages before you start your examination.

2. This paper contains **SIX (6)** questions. Answer **FOUR (4)** questions only. Marks will be given to the **FIRST OUR (4)** questions put in order on the answer script and **NOT** the **BEST FOUR (4)**.

3. All questions carry equal marks.

4. All questions **MUST BE** answered in Bahasa Malaysia.

5. Write answered question numbers on the cover sheet of the answer script.

1. Three products, A, B and C were produced using two manufacturing processes. The time required to produce a unit of each product is given in the table below:

	Manufacturing time per one unit product	
Product	**Process 1**	**Process 2**
A	2	2
B	1	3
C	2	1

The time allocated for Process 1 is 36 hours and for Process 2 is 40 hours. Product A can be sold at RM9, Product B at RM6 and Product C at RM8. Market survey indicates that no more than 6 units of Product C can be sold.

Formulate this problem as a linear programming model and solve this problem using an appropriate **simplex method**.

(25 marks)

2. (a) Define the following terms:

I. Feasibility condition for the simplex method.

II. Feasible solution.

III. Periodic review system.

IV. Free float.

V. Tree.

(10 marks)

2. (b) Solve the following linear programming problem using an appropriate **simplex method**.

Maximize $z = 2x_1 + 4x_2 - x_3$

subject to

$$\begin{aligned} 3x_2 - x_3 &\le 30 \\ 2x_1 - x_2 + x_3 &\le 10 \\ 4x_1 + 2x_2 - 2x_3 &\le 40 \\ x_1, x_2, x_3 &\ge 0 \end{aligned}$$

(15 marks)

3. (a) Explain clearly the **FOUR (4)** inventory cost components.

(8 marks)

(b) Powerco has three electric power plants (S1, S2, S3) that supply electricity to four cities (B1, B2, B3, B4). Each electric power plant can supply 35 million kwh, 50 million kwh and 40 million kwh of electricity respectively. The maximum demand of each city is as follows:

B1 requires 45 million kwh

B2 requires 20 million kwh

B3 requires 30 million kwh

B4 requires 30 million kwh

The transportation cost of 1 million kwh electricity from each power plant to each city is given below:

	B1	B2	B3	B4
S1	8	6	10	9
S2	9	12	13	7
S3	14	9	16	5

Solve this transportation problem so that the cost of supplying electricity from the electric power plants to the cities can be minimized.

(17 marks)

4. (a) Explain clearly the following terms:

   (i) Critical activity.

   (ii) Non critical activity.

   (iii) Free float.

   (iv) Total float.

(8 marks)

(b) A company is preparing a budget to launch a new product. The following table provides the activities and duration (in days) to complete the budget:

	Activity	Immediate Predecessors	Duration (days)
A	Predict amount of sales	-	10
B	Survey market	-	7
C	Design item and facility	A	5
D	Complete the production schedule	C	3
E	Estimate production cost	D	2
F	Decide the selling price	B,E	1
G	Prepare budget	F	14

(i) Draw the project network.

(9 marks)

(ii) Find the critical path for this network.

(8 marks)

5. (a) The cost of assigning workers to machines are given in the following table:

		Machine			
		M1	M2	M3	M4
Worker	A	1	4	6	3
	B	9	7	10	9
	C	4	5	11	7
	D	8	9	8	5

Solve this problem so that the cost of assigning workers to machines can be minimized.

(10 marks)

5. (b) Let p_n be the probability that there are n customers in a system which is in steady state. Show that

$$p_n = \frac{\lambda_{n-1}\,\lambda_{n-2}\cdots\lambda_1\,\lambda_0}{\mu_n\,\mu_{n-1}\cdots\mu_2\,\mu_1}\,p_0$$

(7 marks)

(c) Explain clearly the following terms:

(i) Degeneracy.

(ii) Alternative optimum solution.

(iii) Unbounded solution.

(iv) No feasible solution.

(8 marks)

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