UNIVERSITI SAINS MALAYSIA

2nd. Semester Examination
2004/2005 Academic Session

March 2005

EUM 213/3 – OPERATIONS RESEARCH

Time: 3 hours

Instructions to candidates:

1. Ensure that this paper contains **FOUR (4)** printed pages before you start your examination.

2. This paper contains **FIVE (5)** questions. Answer **FOUR (4)** questions only. Marks will be given to the **FIRST FOUR (4)** questions put in order on the answer script and **NOT** the **BEST FOUR (4).**

3. Each question carry equal marks.

4. All questions **MUST BE** answered in English.

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

6. The use of non-programmable calculators is allowed.

…2/-

1. Company manufactures two types of materials A and B using two raw materials R_1 and R_2. The following table gives the necessary information.

Raw material	Units needed to produce 1 ton of		Units available
	A	B	
R_1	1	2	6000
R_2	2	1	8000
Net profit per ton	7	5	
Maximum demand	3500	2500	

Formulate a linear programming model to determine the number of tons of material A and B to be produced and solve it using a suitable simplex method.

(25 marks)

2. (a) Write the following linear programming problem in standard form

Maximize $z = 2x_1 + 3_2 + 5x_3$

subject to

$$\begin{aligned} x_1 + \ x_2 + 3x_3 &\geq \ 10 \\ -2x_1 + 3x_2 - 5x_3 &\leq \ -15 \\ 7x_1 - 4x_2 \qquad &\leq \ 6 \end{aligned}$$

x_1 unrestricted, $x_2 \leq 0$, $2 \leq x_3 \leq 5$

You are not required to solve this problem.

(10 marks)

(b) Solve the following linear programming problem using the M method.

Minimize $z = -2x_1 + 2x_2 + x_3$

subject to

$$\begin{aligned} x_2 + \ x_3 - x_4 + x_5 + 2x_6 &\leq 6 \\ x_1 \quad + \ x_3 - x_4 + x_5 \qquad &= 5 \\ -x_1 \ + x_2 \ - x_3 + x_4 \quad + x_6 \ &= 3 \end{aligned}$$

$x_1, x_2, x_3, x_4, x_5, x_6 \geq 0$

(15 marks)

3. (a) Describe clearly the difference between critical path method (CPM) and performance evaluation and review technique (PERT).

(5 marks)

(b) A project consists of jobs A to H with immediate predecessor (IP) and job duration data as given below.

Activity	IP	Duration
A	-	3
B	-	2
C	A	5
D	A,B	4
E	B	3
F	D,E	4
G	E	3
H	C,F,G	1

(i) Draw the arrow diagram and find the critical path.

(10 marks)

(ii) Construct a time chart for this project.

(10 marks)

4. (a) Define the following terms as clearly as possible:

(i) slack variable

(ii) optimization rule for the dual simplex method

(iii) critical path

(iv) expected number of customers in a queueing system

(v) periodic review case in the inventory model

(10 marks)

(b) An oil company operates 3 refineries (KP1, KP2, KP3) and sells its gas through 4 depots. The data is given below.

	Cost per unit				Available units (in 10^6 gal)
	Depot 1	Depot 2	Depot 3	Depot 4	
KP1	4	7	9	10	8
KP2	6	4	3	6	10
KP3	9	6	4	8	6
Requirement	5	3	8	4	

By using the north-west corner rule, determine an optimum transportation policy.

(15 marks)

…4/-

5. (a) Describe clearly the meaning of Poisson process.

(5 marks)

(b) A supplier charges RM25 per item if a shopkeeper orders less than 6 items and RM20 if the shopkeeper purchases more than 5 items. If there is a fixed cost of RM10, storage cost of RM5 per item per week and a demand of 3 per week, how frequently should you order if backlogging is not allowed?

(10 marks)

(c) In a motorway service area you can eat either in the restaurant or in the self-service cafeteria. There is never any queue in the restaurant and it will take 25 minutes to eat your meal. In the self-service cafeteria the time for collecting your food and paying for it is exponentially distributed with mean 2 minutes and it takes a further 10 minutes to eat your food. If people arrive at the cafeteria at the rate of 25 per hour, and each one cannot be served until the previous person has paid for his food, decide which is the quicker way to get a meal.

(10 marks)

- ooo O ooo -