EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE 2003/2004

(June/July'2005)

(Repeat)

MT 305 - OPERATIONAL RESEARCH

Answer five questions only

Time: Three hours

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1. Explain the following terms in optimization theory:

   (a) Feasible region.

   (b) Redundant constraint.

A farm is engaged in breeding pigs. The pigs are fed on various products grown on the farm. Because of the need to ensure certain nutrient constituents, it is necessary to buy additionally one or two products, which we shall call A and B. The nutrient constituents (vitamins and proteins) in each unit of the products are given below. Product A costs Rs.20 per unit and product B costs Rs40 per unit.

Nutrient	Nutrient contents in the products		Minimum amount of nutrients
	A	B	
1	36	6	108
2	3	12	36
3	20	10	100

How much of products A and B be purchased at the lowest possible cost so as to provide the pigs, subject to the nutrient not less than that given in the table?

2. Explain the method of selection of a pivot element in the simplex method.

An industrial process uses three grades of coal C_1, C_2 and C_3 which contain phosphorus and ash as impurities. The total quantity of fuel required is 100 tonne and it should contain ash not more than 3% and phosphorus not more than 0.03%. The following table represents the impurities and profit of each grade:

Coal	Phosphorus (%)	Ash (%)	Profit per tonne (Rs.)
C_1	0.02	3	12
C_2	0.04	2	15
C_3	0.03	5	14

Find the proportions in which the three grades be used to maximize the profit. Assume that there is unlimited supply of each grade.

3. Write down the dual simplex algorithm.

Use the dual simplex method to solve the following problem:

Maximize $Z = -3x_1 - 2x_2$

subject to
$$\begin{aligned} x_1 + x_2 &\geq 1 \\ x_1 + x_2 &\leq 7 \\ x_1 + 2x_2 &\geq 10 \\ x_2 &\leq 3 \\ x_1 \, , \, x_2 &\geq 0. \end{aligned}$$

4. Use the Revised simplex method to

Maximize $Z = 6x_1 + 3x_2 + 4x_3 - 2x_4 + x_5$

subject to
$$\begin{aligned} 2x_1 + 3x_2 + 3x_3 + x_4 &= 10 \\ x_1 + 2x_2 + x_3 + x_5 &= 8 \\ x_1 \, , \, x_2, \, x_3, \, x_4, \, x_5 &\geq 0. \end{aligned}$$

5. Briefly explain the "Vogel's approximation method".

The Machine Oil supplies limited have four factories F_1, F_2, F_3 and F_4 containing special machine oil. The company supply the oil to four distribution centers A, B, C, D with daily demand 10, 12, 14, 16gallons respectively. Transportation costs in rupees per gallon, from factory to the distribution centers are given below:

Factories	A	B	C	D
F_1	7	3	12	9
F_2	8	11	3	21
F_3	6	15	10	20
F_4	10	3	8	3

The four factories could supply daily production capacities for the products are 8 gallons at F_1, 12 gallons at F_2, 15 gallons at F_3 and 10 gallons at F_4.

(a) Use Vogel's approximation method to find the initial basic feasible solution.

(b) Determine the optimum allocation procedure which will minimize costs and obtain the daily cost for this procedure.

6. Briefly explain the "Hungarian method" for solving assignment problems.

A company is faced with the problem of assigning six different machines to five different jobs. The costs estimated in hundreds of rupees are given in the table below.

Jobs	1	2	3	4	5
1	2.5	5	1	6	2
2	2	5	1.5	7	3
Machines 3	3	6.5	2	8	3
4	3.5	7	2	9	4.5
5	4	7	3	9	6
6	6	9	5	10	6

Solve the problem by minimizing the total cost.

7. Give a brief explanation for Mack's method of solution of an Assignment problems.

Five wagons are available at five stations $1, 2, 3, 4$ and 5. These are required at five stations A, B, C, D and E. The mileage between different stations are given by the table below.

	A	B	C	D	E
1	10	5	9	18	11
2	13	19	6	12	14
3	3	2	4	4	5
4	18	9	12	17	15
5	11	6	14	19	10

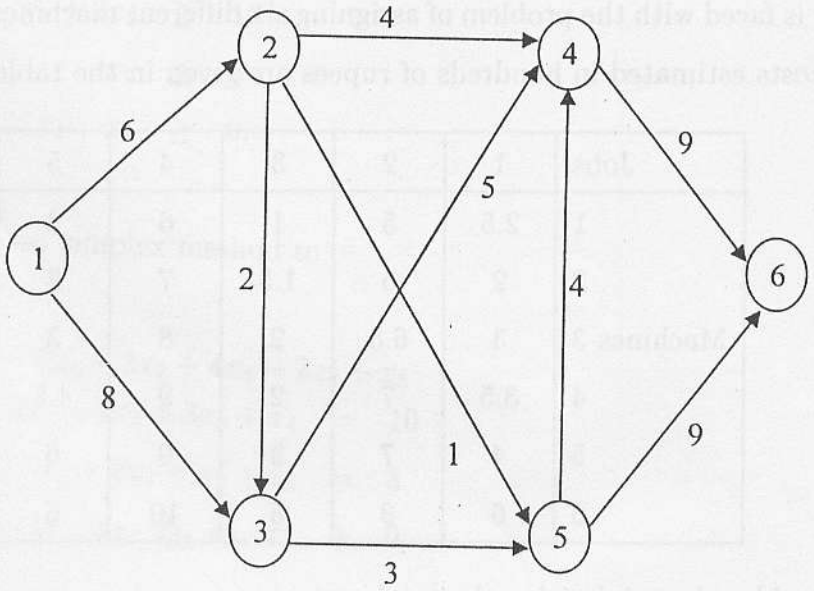
How the wagons be transported so as to minimize the total mileage covered? Formulate the problem as a linear programming problem.

8. (a) Define the following terms.

(i) Graph, (ii) Path, (iii) Loop,

(iv) Tree, (v) Source.

(b) Find the maximal flow for the following network using the labeling technique.



(c) Find the shortest distance and path from the node 1 to 10 in the network given below.