EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE 2002/2003

(June./July.'2003)

FIRST SEMESTER

MT 305 - OPERATIONAL RESEARCH

Answer all questions

Time : Three hours

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1. (a) Define the term "linear program".

   (b) Define the term "feasible region" of a linear programming problem.

The Reddy Mikks company owns a small paint factory that produces both interior and exterior house paint for wholesale distribution. Two basic raw materials, A and B, are used to manufacture the paints. The maximum availability of A is 6 tons a day; that of B is 8 tons a day. The daily requirements of the raw materials per ton of interior and exterior paints are summarized in the following table.

Raw material	Tons of raw material per ton of paint		Maximum Availability(tons)
	Exterior	Interior	
A	1	2	6
B	2	1	8

A market survey has established that the daily demand for interior paint cannot exceed that of exterior paint by more than 1 ton. The survey also shows that the maximum demand for interior paint is limited to 2 tons daily. The wholesale price per ton is Rs.3000 for exterior paint and Rs.2000 for interior paint.

(i) Formulate the problem as a linear programming problem.

(ii) Use graphical method to find how much interior and exterior paints should the company produce daily to maximize gross income.

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

Mohan-Meakings Limited has two bottling plants, one located at Solan and the other at Mohan Nagar. Each plant produces three drinks, Pineapple, Woodapple and Orange. The number of bottles produced per day are as follows:

	Solan (S)	Mohan Nagar (M)
Pineapple	1500	1500
Woodapple	3000	1000
Orange	2000	5000

A market survey indicates that during the month of April, there will be a demand of 20,000 bottles of pineapple, 40,000 bottles of woodapple and 44,000 bottles of orange. The operating cost per day for plants at Solan and Mohan Nagar are 600 and 400 monetary units.

(a) Formulate the problem as a linear programming problem.

(b) Use Simplex method to find how many days each plant be run in April so as to minimize the production cost, while meeting the market demand?

3. Rusty MacHinery runs a small machine shop where she can produce three structural elements for well drilling companies. The profits on the three items are Rs.10, Rs.8 and Rs.6 per unit. Item 1 takes 2 hours on machine A and 1 hour on machine B. Item 2 requires 1 hour on A and 4 hours on B; item 3, 1 hour on A and 1 hour on B. Machine A operates a maximum of 12 hours per day, and machine B operates no more than 8 hours per day. Rusty wishes to maximize her daily profits, subject to the availability of machine time on the two machines.

(a) Formulate the problem as a linear programming problem.

(b) Write the dual problem of (a).

(c) Find the optimal solution of the problem using its dual.

4. Use the Revised Simplex method to solve the following problem.

$$\text{Min } Z = 2x_1 + x_2$$

$$\begin{aligned} \text{subject to} \quad 3x_1 + x_2 &= 3 \\ 4x_1 + 3x_2 &\geq 6 \\ x_1 + 2x_2 &\leq 3 \\ \text{and } x_1,\ x_2 &\geq 0. \end{aligned}$$

5. Explain the North-West corner method.

A company produces a small component for an industrial product and distributes it to five wholesalers at a fixed delivered price Rs.250 per unit. Sales forecasts indicate that monthly deliveries will be 300, 300, 100, 500 and 400 units to wholesalers 1, 2, 3, 4 and 5 respectively. The direct costs of production of each unit are Rs.100, Rs.90 and Rs.80 at plants 1, 2 and 3 respectively. The transportation costs of shipping a unit from plants to wholesalers are given below:

Plant	wholesalers				
	1	2	3	4	5
1	5	7	10	15	15
2	8	6	9	12	14
3	10	9	8	10	15

Take the monthly production capacities of plants 1, 2 and 3 as 500, 100 and 1250 units respectively.

(a) Use the North-West corner method to find the initial basic feasible solution to maximize the profit.

(b) Determine the optimal solution.

6. (a) Define the following terms:

   i. Graph,

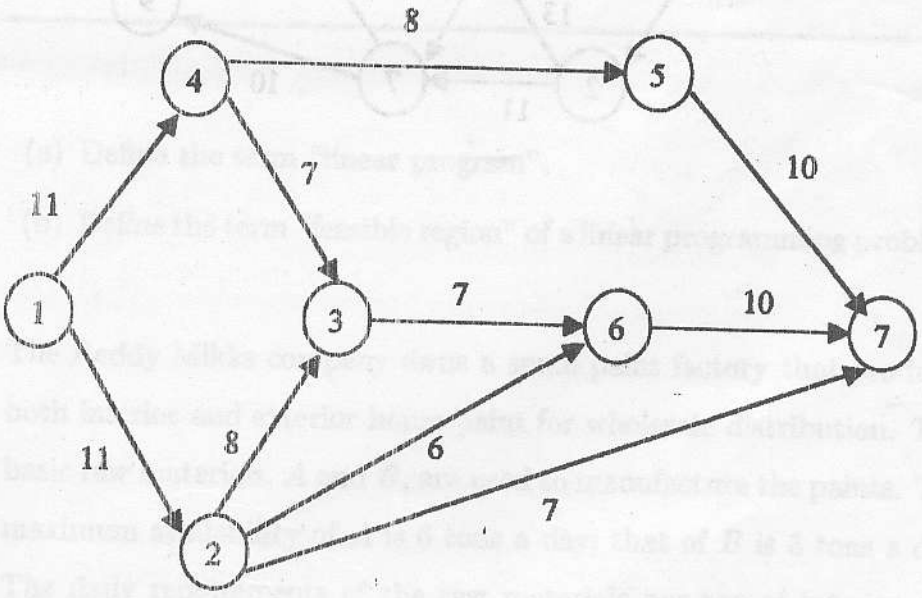
   ii. Path,

   iii. Loop,

   iv. Tree,

   v. Source.

(b) Use the labeling technique to find the maximal flow for the following network.



(c) Find the shortest distance and the shortest path for the following network.