6. (a) (i) Write short notes on Slack and Surplus variables.

(ii) Justify the statement 'Graphical solution is not possible for LPP with more than two variables'.

(b) Explain Hungarian method for solving assignment problem.

(c) Give a brief outline of the procedure for solving transportation problem. (6,6,6)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 9736 **K**

Unique Paper Code : 2373570005 NEP-UGCF

Name of the Paper : DSE: Linear Programming Techniques

Name of the Course : **B.A. (P) / B.Sc. (P) Mathematical Sciences**

Semester : VII

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **five** questions in all.
3. Q. No. **1** is compulsory.
4. Use of a non-programmable scientific calculator is allowed.

P.T.O.

1. Answer the following :

(a) An optimal solution of an assignment problem can be obtained if the number of assigned cells is _____ to the number of rows/column. (1)

(b) In a balanced transportation problem with m sources and n destinations, the number of non basic feasible variables are _____. (1)

(c) Slack variables in a LPP convert a constraint into an equation when the constraint is _____ type. (1)

(d) Assignment problem is a special case of _____ problem. (1)

(e) In a minimization problem of a simplex table, if $Z_j - C_j = 0$ for at least one non-basic variable, then there will be _____ solution. (1)

(f) The cost coefficient of surplus variable in objective function is _____. (1)

(g) Explain the graphical method of solving a LPP involving two variables. (3)

(h) Explain transportation problem and show that it can be mathematically formulated as an LPP. (3)

demand of 5, 15, 15 and 15 truckloads respectively. The unit transportation cost per truckload on the different routes is given below :

Warehouse	Mills			
	1	2	3	4
A	10	2	20	11
B	12	7	9	20
C	4	14	16	18

Solve the problem to get the optimal transportation schedule in order to maximize the transportation cost.

(b) Find the initial basic feasible solution of the following transportation problem using north west comer method and least cost method. Also, compute the transportation cost on the basis of initial basic feasible solution and compare the results.

Factory↓	Warehouse				
	W1	W2	W3	W4	Factory capacity
F1	19	30	50	10	7
F2	70	30	40	60	9
F3	40	8	70	20	18
Warehouse requirement	5	8	7	14	3

(9,9)

4. (a) Solve the following LPP using Big-M method :

Maximize $Z = 6x_1 + 4x_2$

subject to constraints:

$$2x_1 + 3x_2 \leq 30$$

$$3x_1 + 2x_2 \leq 24$$

$$x_1 + x_2 \geq 3$$

$$x_1, x_2 \geq 0$$

(b) Describe assignment problem and also, formulate it mathematically.

A company wishes to assign 3 jobs to 3 machines in such a way that each job is assigned to some machine and no machine works on more than one job. The cost of assigning job i to machine j is given by the following matrix :

Cost matrix :

8	7	6
5	7	8
6	8	7

Formulate the given problem as LPP. (9,9)

5. (a) A transport company ships truckloads of grains from three warehouses with supply capacity of 25, 25 and 10 truckloads to four mills with the

(i) Reduce the following LPP into its standard form

Maximize $Z = 3x_1 + 4x_2 + 6x_3$

Subject to the constraints :

$$2x_1 + x_2 + 2x_3 \geq 6,$$

$$7x_1 - 3x_2 + 5x_3 \geq 9,$$

$$3x_1 + 2x_2 = 8,$$

$x_1 \geq 0$, $x_2 \geq 0$ and x_3 unrestricted in size. (3)

(j) Compute all the basic solutions to the following system of linear equations :

$$4x_1 + 2x_2 + x_3 = 7$$

$$-x_1 + 4x_2 + 2x_3 = 14$$ (3)

2. (a) A company that produces soft drinks has a contract that requires a minimum of 80 units of chemical A and 60 units of chemical B to go into each bottle of the drink. The chemicals are available in a prepared mix from two different suppliers. Supplier X_1 has a mix of 4 unit of A and 2 units of B that costs Rs.10, and supplier X_2 has a mix of 1 unit of A and 1 unit of B that costs Rs.4. How many mixes from company X_1 and company X_2 should

the company purchase to honour contract requirements and yet minimize the cost? Formulate the problem as LPP and solve it graphically.

(b) A department head has four tasks to be performed and three subordinates, the subordinates differ in efficiency. The estimates of the time, each subordinate would take to perform the task is given below. How should he allocate the tasks one to each subordinate, so as to minimize the total man-hours?

Subordinate→	1	2	3
Task1	9	26	15
Task2	13	27	6
Task3	35	20	15
Task4	18	30	20

(9,9)

3. (a) Consider the following L.P.P. :

Max. $Z = 4x_1 + 10x_2$

subject to constraints:

$$2x_1 + x_2 \leq a_1$$

$$2x_1 + 5x_2 \leq a_2$$

$$2x_1 + 3x_2 \leq a_3$$

$$x_1, x_2 \geq 0$$

where a_1, a_2 and a_3 are constants. For specific values of a_1, a_2 and a_3 the optimal solution is :

Basis	x_B	x_1	x_2	x_3	x_4	x_5
x_3	30	b_1	0	1	$\frac{-1}{5}$	0
x_2	20	b_2	1	0	$\frac{1}{5}$	0
x_5	30	b_3	0	0	$\frac{-3}{5}$	1
$Z_j - c_j$	Z=200	0	0	0	d	e

Evaluate the following :

(i) The values of a_1 a_2 and a_3 that yield the given optimal solution.

(ii) The values of b_1, b_2 and b_3, d and e in the above given optimal table.

(b) Explain Two phase simplex method for solving a LPP. (9,9)