Time : 2 ½ hours.   Max.Marks : 75

Note : 1) All questions are compulsory
       2) Attempt any one question from 'a' and 'b' and any one from 'c' and 'd'
       3) Graph papers will be provided on request.
       4) Calculators are allowed .
       5) Figures to the right indicate marks.

Q.1

a) Define the following terms in a Linear programming problem .(L.P.P)
   (i) Slack Variable .
   (ii) Artificial variable .
   (iii) Feasible solution .
   (iv) Basic feasible solution .
   (iv) Optimum basic feasible solution .   (8)

b) Solve the following L.P.P using simplex method :-

       Max Z= $3x_1 + 2x_2 + 5x_3$
   Subject to
       $x_1 + 2x_2 + x_3 \leq 430$
       $3x_1 + 2x_3 \leq 460$
       $x_1 + 4x_2 \leq 420$
       $x_1 , x_2 , x_3 \geq 0.$ (8)

c) Solve the following L.P.P graphically :-
   Min $Z = 12x + 20y$
   Subject to
       $x + y \geq 7$
       $5x + 2y \geq 20$
       $x \geq 0, y \geq 0$ (7)

d) A pharmaceutical company produces two types of calcium tablets .First type of tablet requires 20 mg of calcium , 40 mg of vitamin C and 2 mg of vitamin D. Second tablet contains 30 mg of calcium , 30 mg of vitamin C and 4 mg of vitamin D. Minimum requirement of these are 110 mg, 150 mg and 30 mg respectively. The cost of calcium tablets are Rs.15 and Rs.30 respectively.
   Formulate the L.P.P.   (7)

Q.2

a) Explain transportation problem .Define balanced transportation problem .Give the mathematical formulation of the transportation problem. What is the difference between the transportation problem and assignment problem. How do you detect and find alternate optimal solution in a transportation Problem.?   (8)

b) A company has three factories F_1, F_2, F_3 with capacities of 200,150 and 250 units. It has 3 warehouses W_1, W_2, and W_3 with demands 250, 150 200 units respectively. Unit cost of transportation is given in the table below. Obtain the initial feasible solution by using :---
 p) North – West corner rule.
 q) Matrix minima method.
 And compare the transportation cost obtained in each method.

	W_1	W_2	W_3
F_1	14	12	9
F_2	8	10	13
F_3	11	16	7

(8)

c) Explain Vogel's approximation method of finding initial basic feasible solution to the following transportation :-

Origin	Destination				Supply
	D_1	D_2	D_3	D_4	
O_1	1	2	1	4	30
O_2	3	3	2	1	50
O_3	4	2	5	9	20
Demand	20	40	30	10	

(7)

d) Solve the following transportation problem using least cost entry method.

FROM	TO			SUPPLLY
	W	X	Y	
P	16	24	24	152
Q	48	72	48	164
R	24	48	72	154
DEMAND	144	204	82	

(7)

Q.3 a) What is an Assignment problem. Give two areas of its application. Explain Hungarian method to solve assignment problem.

(8)

b) A company has 4 machines to do 4 jobs. Each job can be assigned to any one machine. The cost of each job –machine combination is given in the tables below in Rupees.

Jobs:-	Machine -→			
	I	II	III	IV
A	51	77	49	55
B	32	34	59	68
C	37	44	70	54
D	55	55	58	55

Find the optimal assignment which will minimize the cost using Hungarian method.

(8)

c) Define Job –Sequencing problem . Explain Johnson's algorithm for n jobs 2
Machines.   (7)

d) Find the sequence that minimizes the total time required in performing the
following jobs on three machines in the order ABC.

MACHINES	JOBS					
	1	2	3	4	5	6
A	8	3	7	2	3	1
B	3	4	5	2	1	6
C	8	7	6	9	10	9

(7)

Q.4   a) A business problem is formulated and   expressed below as a linear programming
problem.
X_1 = Production of A.
X_2 = Production of B.
The resources required to produce A & B are R_1 and R_2.
Maximize $Z = 10x_1 + 4x_2$
Subject to

$$20x_1 + 10x_2 \leq 1200 \qquad ----- \quad -R_1$$
$$40x_1 + 10x_2 \leq 1600 \qquad ----- \quad -R_2$$
$$x_1 \geq 0, \ x_2 \geq 0.$$

By the simplex method , we get the following feasible solution

Cost of Basic variables	Basic variables	C_j ---→ b_j	10 X_1	4 X_2	0 S_1	0 S_2
0	S_1	400	0	5	1	-1/2
10	X_1	40	1	1/4	0	1/40

Find the optimal solution from the above simplex table and write the product mix and the
maximum profit.   (5)

b)   A steel company has three open hearth furnaces and five rolling mills .
Transportation cost (rupees per quintal) for shipping steel from furnaces to rolling
mills are shown in the following table :-

Furnaces	MILLS						Capacities
	M_1	M_2	M_3	M_4	M_5	$M_{7(dummy)}$	
F_1	4	2	3	2	6	0	8
F_2	5	4	5	2	1	0	12
F_3	6	5	4	7	3	0	14
Requirements	4	4	6	8	8	4	

Given the initial basic feasible solution :- Furnaces ---→ Mills Quantity (in quintals)

F_1 ------→ M_2	4
F_1 ------→ M_4	4
F_2 ------→ M_4	4
F_2 -----→ M_5	8
F_3 ------→ M_1	4
F_3 -----→ M_3	6
F_3 -----→ M_7	4

Test the above solution for optimality.   (5)

c) A company has to appoint one sales executive each in four areas. Profit potential of executives is given below in Rs. thousands. Find optimal assignment of executives and area.

Executives	Areas			
	A_1	A_2	A_3	A_4
E_1	70	54	56	74
E_2	56	68	58	80
E_3	70	48	64	66
E_4	48	64	50	56

(5)

d) Seven jobs are to be processed on two machines A and B in the order AB. Each machine can process only one job at a time. The processing times (in hours) are as follows :-

JOB :-	1	2	3	4	5	6	7
MACHINE A:-	10	12	13	7	14	5	16
MACHINE B:-	15	11	8	9	6	7	16

(5)

Find the sequence that minimizes the total elapsed time.

— ✕ —