Time : $2\frac{1}{2}$ hours. Max.Marks : 75

Note : 1) All questions are compulsory
2) Attempt any two sub questions out of four in question numbers 1,2 & 3
3) Attempt any three sub questions out of four in question number 4.
4) Graph papers will be provided on request.
5) Calculators are allowed .
6) Figures to the right indicate marks.

Q.1 (a) i) What is a Linear Programming problem (L.P.P) (10)
ii) Define the following terms for a L.P.P :-
1) Feasible Solution.
2) Basic solution.
3) Basic feasible solution .
4) Optimum Basic feasible solution.
5) Slack and Surplus variable.

(b) Formulate the following L.P.P:- (10)
A manufacturer produces two types of scooters ,regular and deluxe ,each of which is processed through three machines M_1 ,M_2 and M_3 . Machine M_1 has a maximum of 150 hours available , machine M_2 has a maximum of 180 hours available and machine M_3 can work for at the most 210 hours. The regular type of scooter requires 10 hours , 25 hours and 16 hours on machines M_1 , M_2 and M_3 respectively . The deluxe type of scooter requires 14 hours , 22 hours and 18 hours on these machines. If the profits per piece are Rs. 2800 for a regular type and Rs. 3400 for a deluxe type of scooter , formulate the linear programming problem.

(c) Solve the following Linear programming problem graphically :- (10)
Maximize $Z = 6x + 4y$
Subject to :- $2x + 3y \leq 30$
$3x + 2y \leq 24$
$x , y \geq 0$

(d) Solve the following L.P.P using simplex method :- (10)
Min $Z = x_1 - 3x_2 + 2x_3$
Subject to :- $3x_1 - x_2 + 3x_3 \leq 7$,
$-2x_1 + 4x_2 \leq 12$,
$-4x_1 + 3x_2 + 8x_3 \leq 10$,
$x \geq 0$, $y \geq 0$

Q.2 (a) Define the Transportation problem . Give the mathematical form of the transportation problem .Explain the difference between a transportation problem and an assignment problem . (10)

(b) Find the initial basic feasible solution for the following transportation problem using :- (10)
(i) North West Corner Rule.
(ii) Least Cost Entry method.

Warehouses :-	W_1	W_2	W_3	W_4	W_5	Availability
Plant						
P_1	20	28	32	55	70	50
P_2	48	36	40	44	25	100
P_3	35	55	22	45	48	150
Requirements	100	70	50	40	40	

(c) There are three sources or origins which store a given product. These sources supply these products to four dealers. The capacities of the sources and the demands are as given below : (10)

Destination :-	D_1	D_2	D_3	D_4	Supply
Sources					
S_1	27	23	31	69	150
S_2	10	45	40	32	40
S_3	30	54	35	57	80
Demand	90	70	50	60	

Find out the optimum solution for transporting the products at a minimum cost.

(d) A company is spending Rs.1200 on transportation of finished goods from three plants to four distribution centres every month. The supply and demand for finished goods every month with unit cost of transportation are given in the following table :- (10)

	D_1	D_2	D_3	D_4	Monthly Capacity in Units
F_1	20	30	50	15	7
F_2	70	35	40	60	10
F_3	40	12	60	25	18
Monthly Demand in units	5	8	7	15	35

Given the Initial Basic Feasible solution :-
F_1 to D_1 :5, F_1 to D_4 : 2, F_2 to D_3 :7, F_2 to D_4 :3,
F_3 to D_2 : 8, F_3 to D_4 :10.
Determine whether the solution is optimum. If not determine the optimal solution. What can be the maximum saving every month by optimal scheduling?

Q.3 (a) What is an Assignment problem? Explain the Hungarian method to solve an assignment problem. (10)

(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. (10)

	Machine -→			
Job	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.

(c) Explain what do you mean by sequencing problem.
Explain the following terms :- (10)
i) Number of machine.
ii) Processing order.
iii) Processing time.
iv) Idle time on Machine.
v) Total Elapsed Time.
vi) No passing rule.

(d) Find the sequence that minimizes the total time required in performing the following jobs on three machines in the order ABC.:- (10)

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

Q.4 a) Solve the following L.P.P using simplex method .:- (5)

Max $Z = 2x_1 + x_2$

Subject to :- $x_1 - x_2 \le 10$,

$2x_1 - x_2 \le 40$,

$x_1 \ge 0,\ x_2 \ge 0.$

(b) **Ozone** company produces two products **A** and **B**. Product A is produced by using 4 units of chemical salt and 2 units of chemical mixture. Product B is produced by using 2 units of chemical salt and 3 units of chemical mixture. Only 1000 units of chemical salt and 1500 units of chemical mixture are available. The profit on product A is Rs.30 and on B is Rs.20 per unit. Formulate this L.P.P , (5)

(c) 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 :- (5)

		M_1	M_2	M_3	M_4	M_5	Capacity
	F_1	4	2	3	2	6	8
Furnaces:-	F_2	5	4	5	2	1	12
	F_3	6	5	4	7	2	14
Requirements (In quintals)	:-	4	4	6	8	8	

Determine the initial basic feasible solution using Vogel's approximation.

(d) Find the sequence that minimizes the total elapsed time required to complete the following jobs :- (5)

Processing time in hours:-

No. of Jobs	1	2	3	4	5	6
Machine A :-	4	8	3	6	7	5
Machine B:-	6	3	7	2	8	4

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