1) What is Constraints in LPP.?

A: The linear inequalities or Equations or restrictions on the Variables of a linear Programming Problems are Called Constraints.

The Conditions $x \geq 0, y \geq 0$ are Called non-negative restrictions

Eg: $\left.\begin{matrix} x & 0 \\ y & 0 \end{matrix}\right\}$ non negative Constraints

$5x + y \leq 0$

$x + y \leq 60 \ldots$

---

2) How do you Solve an Unbalanced tranportion Problem?

A: Unbalanced transportation Problem is defined as a Situation in which Supply and demand are not Equal. A dummy row or a dummy Column is added to this type of Problem, depending on the necessity to make it a balanced Problem The Problem. The Problem Can then be addressed in the Same way as the balanced Problem

There are three ways to Solve transportation Problems:

1) North west Corner Cell method
2) Vogel's approximation method
3) least Cell method

---

3) What do you mean by LPP, What are its limitations. By using Penalty or Big M method

Q) Solve max $Z = 3x_1 - x_2$.
Subjected to the Constraints

$$2x_1 + x_2 \geq 2$$
$$x_1 + 3x_2 \leq 3$$
$$x_2 \leq 4$$
$$x_1, x_2 \geq 0$$

Ans linear Programming Problems is a System Process of finding a maximum or minimum Value of any Variable in a function It is also known by the name of optimization Problem. LPP is helpful in developing & Solving a decision making Problem by mathematical techniques

Limitations.

1) It is not simple to Specify the Constraints Even after the determination of

function Specifications Constraints is difficult.

2) There is a Possibility that both function are linear

3) Determining the given function mathematically in a linear Programming Problem is quite difficult

4) The assumptions made are not real since they are taken based on the Elements in the given Situation

ii) A) Max $Z = 3x_1 - x_2$

Sub to: $2x_1 + x_2 \geq 2$

$x_1 + 3x_2 \leq 3$

$x_2 \leq 4$

$x_1, x_2 \geq 0$

WKT

Max $Z = 3x_1 - x_2$

Sub to: $2x_1 + x_2 - S_1 = 2$

$x_1 + 3x_2 + S_2 = 3$

$x_2 + S_3 = 4$

$x_1, x_2, S_1, S_2, S_3 \geq 0$

$x_1 = x_2 = 0$ $S_1 = -2$, $S_2 = 3$, $S_3 = 4$

Introduce Slack, Surplus, artificial Variable.

Max $Z = 3x_1 - x_2 + 0S_1 + 0S_2 - MA_1$

Sub to : $2x_1 + x_2 - S_1 + A_1 = 2$

$x_1 + 3x + S_2 + 3$

$x_2 + Z_3 = 4$

An Initial basic feasible Solution is given by

$x_1, x_2 = 0, A_1 = 2, S_2 = 3, S_3 = 4$

C_{Bi}	C_j	3	-1	0	0	0	-m	Sol	ratio
	Br	x_1	x_2	S_1	S_2	S_3	A		
-M	A_1	2	1	-1	0	0	1	2	1
0	S_2	1	3	0	1	0	0	3	3
0	S_3	0	1	0	0	1	0	4	-
$Z_1 - C_j$		$-2m-3$	$-m+1$	m	0	0	0	$-2m$	

C_{Bi}	C_j	3	-1	0	0	0	-m	Sol	ratio
	BV	x_1	x_2	S_1	S_2	S_3	A_1		
3	x_1	1	$1/2$	$-1/2$	0	0	$1/2$	1	-2
0	S_2	0	$5/2$	$1/2$	1	0	$-1/2$	2	4
0	S_3	0	1	0	0	1	0	4	-
	$Z_j - C_j$	0	$5/2$	$-3/2$	0	0	$3/2+m$	3	

C_{Bi}	C_j	3	-1	0	0	0	-m	Sol	ratio
	BV	x_1	x_2	S_1	S_2	S_3	A_1		
3	x_1	1	3	0	1	0	0	3	×
0	S_1	0	5	1	2	0	-1	4	×
0	S_3	0	1	0	0	1	0	4	×
	$Z_j - C_j$	0	10	0	3	0	m	9	×

Thus the optimum Sol^n is reached

$\therefore x_1 = 3,\ x_2 = 0,\ \text{Max } Z = 9.$

4) Find the optimal Sol^n to the transportation Problem as given in the table.

	D_1	D_2	D_3	D_4	Supply
1	5	3	6	2	19
2	4	7	9	1	37
3	3	4	7	5	34
demand	16	18	31	25	

A- total Supply = 19 + 37 + 34 = 90

total demand = 16 + 18 + 31 + 25 = 90

$\boxed{16}$ $\cancel{5}$	$\boxed{3}$ $\cancel{3}$	$\cancel{6}$	$\cancel{2}$	19-16 = 3-3 = 0
$\cancel{4}$	$\boxed{15}$ $\cancel{7}$	$\boxed{22}$ $\cancel{9}$	$\cancel{1}$	37-15 = 22 = 0
$\cancel{3}$	$\cancel{4}$	$\boxed{9}$ $\cancel{7}$	$\boxed{25}$ $\cancel{5}$	34-9 = 23 = 0
$\cancel{16}$ 0	$\cancel{18}$ 0	31-22 = $\cancel{9}$ 0	$\cancel{25}$ 0	

5 $\boxed{16}$	3 $\boxed{3}$	6	2	$u_1=0$
4	7 $\boxed{15}$	9 $\boxed{22}^{-x}$	$+x$ 1	$u_2=4$
3	4	$7+x$ $\boxed{9}$	$5-x$ $\boxed{25}$	$u_3=2$
$v_1=5$	$v_2=3$	$v_3=5$	$v_4=3$	

to find, Δij, we have $\Delta ij = c_{ij} - (u_i + v_j)$

$\Delta_{13}=1$; $\Delta_{14}=-1$; $\Delta_{21}=-5$, $\Delta_{24}=-6$; $\Delta_{31}=-4$,

$\Delta_{32}=-1$

$5\times \cancel{2}6 + 3\times 3 + 7\times 15 + 9\times 22 + 9\times 7 + 5\times 25$

$= 580$

$\Delta_{24}=-6$ as most negative

$x = \min(22, 25)$

5 $\boxed{16}$	3 $\boxed{3}$	6	2	$u_1=0$
4	7 $\boxed{15}$	9	$\boxed{22}$ $(+x)$	$u_2=4$
$3+x$	4	7	$\boxed{3}$ $5(-x)$	$u_3=8$

$\Delta_{3}=7$; $\Delta_{14}=5$; $\Delta_{21}=-5$;

$\Delta_{23}=6$; $\Delta_{31}=-10$; $\Delta_{32}=-7$

$\Delta_{31}=-10$ most '-' ve

4) $(-15, -3, -16)$ $x = +3$

$\boxed{13}$ 5	$\boxed{6}$ 3	6 $+x$	2	$u_1 = 0$
4	$\boxed{12}$ 7	9	$\boxed{25}$ 1	$u_2 = 4$
$\boxed{3}$ 3 $+x$	4	$\boxed{31}$ 7 $-x$	5	$u_3 = -2$
$V_1 = 5$	$V_2 = 3$	$V_3 = 9$	$V_4 = -3$	

$\Delta_{13} = -3$, $\Delta_{14} = 5$, $\Delta_{21} = 3$

$\Delta_{23} = 14$, $\Delta_{32} = 3$, $\Delta_{34} = 10$

$\Delta_{13} = -3$ is most negative

$(-31, -13)$ $x = 13$

A =

5	$\boxed{6}$ 3	$\boxed{13}$ 6	2	$u_1 = 0$
4	$\boxed{12}$ 7	9	$\boxed{25}$ 1	$u_2 = 4$
$\boxed{16}$ 3 $-x$	4	$\boxed{18}$ 7 $+x$	5	$u_3 = 1$
$V_1 = 2$	$V_2 = 3$	$V_3 = 6$	$V_4 = -3$	

$\Delta_{11} = 3$, $\Delta_{14} = 5$, $\Delta_{21} = -2$

$\Delta_{23} = -1$, $\Delta_{32} = 0$, $\Delta_{34} = 7$

$\Delta_{21} = -2$ is most negative.

$(13, 16, 12)$ $x = 12$

5	3 [18]	6 [1]	2	$u_1 = 0$
4	7	9	1	$u_2 = 2$
[4] 3	4	[30] 7	5	$u_3 = 1$
$v_1 = 2$	$v_2 = 3$	$v_3 = 6$	$v_4 = 1$	

$\Delta_{11} = 3, \quad \Delta_{14} = 3 \quad \Delta_{22} = 2$

$\Delta_{23} = 1 \quad \Delta_{32} = 0 \quad \Delta_{34} = 5$

$x_{12} = 18, \quad x_{13} = 1 \quad x_{21} = 12 \quad x_{24} = 25$

$x_{31} = 4 \quad x_{33} = 30$

min Cost $= 3\times18 + 6\times1 + 4\times12 + 1\times25 + 3\times4 + 7\times30$

$= 355$

5) Solve the following assignment Problem ?

	A	B	C	D
1	11	17	8	20
2	9	7	12	15
3	13	16	15	16
4	14	10	12	13

4 A Row reduction matrix

	A	B	C	D
1	3	9	0	12
2	2	0	5	8
3	0	3	2	3
4	4	0	2	3

~~Column~~ ~~Redu~~ Column reduction matrix

	A	B	C	D
1	3	9	0	9
2	2	0	5	5
3	0	3	2	0
4	4	0	2	0

A

	A	B	C	D
1	3	9	$\boxed{0}$	9
2	2	$\boxed{0}$	5	5
3	$\boxed{0}$	3	2	0
4	4	0	2	$\boxed{0}$

1 - C

2 - B

3 = A

4 - D

Minimum Cost = 8+7+13+13 = 41