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Question # 1

There are total 5 machines and 5 employments are to be relagated and the related cost network is as per the following?

Solution :-

		MACHINES				
		A	B	C	D	E
J	1	6	12	3	11	15
O	2	4	2	7	1	10
B	3	8	11	10	7	11
S	4	16	19	122	23	21
	5	9	5	7	6	10

Step 1:- Row minimization:-

	Machines						
	#	A	B	C	D	E	
J	1	6	12	3	11	15	3
O	2	4	2	7	1	10	1
B	3	8	11	10	7	11	7
S	4	16	19	122	23	21	16
	5	9	5	7	6	10	5

→ Step # 2.

Row Subtraction:-

		Machines				
		A	B	C	D	E
J	1	3	9	0	8	12
D	2	3	1	6	0	9
B	3	1	4	3	0	4
S	4	0	3	106	6	5
	5	4	0	2	1	5

Step # 3.

Column Mnimization.

		Machines				
		A	B	C	D	E
J	1	3	9	0	8	12
O	2	3	1	6	0	9
B	3	1	4	3	0	4
S	4	0	3	106	6	5
	5	4	0	2	1	5
		0	0	0	0	4

→ Step # 4

Column Subtraction.

		Machines				
		A	B	C	D	E
J	1	3	9	0	8	8
O	2	3	1	6	0	5
B	3	1	4	3	0	0
S	4	0	3	106	6	1
	5	4	0	2	1	1

→ Step # 5

Draw horizontal & vertical lines through circles.

		Machines				
		A	B	C	D	E
J	1 ←	3	(0)	(0)	8	8 →
O	2 ←	3	1	6	(0)	5 →
B	3 ←	1	4	3	0	(0) →
S	4 ←	(0)	3	106	6	1 →
	5 ←	4	(0)	2	1	1 →

Hence 5 = 5

Optimal Solution.

→ Step # 6

Timing:

		Machines				
		A	B	C	D	E
J	1	6	12	[3]	11	15
O	2	4	2	7	[1]	10
B	3	8	11	10	7	[11]
S	4	[16]	19	122	23	21
	5	9	[5]	7	6	10

Jobs	operators	Time
1	C	3
2	D	1
3	E	11
4	A	16
5	B	5
		36

Total processing time = 36 Cr. hr.

Q2

Question # 2.

minimization $z = 2x_1 + 3x_2$

subj = $\frac{1}{2}x_1 + \frac{1}{4}x_2 \leq 4$

$x_1 + 3x_2 \geq 20$

$x_1 + x_2 = 10$

$x_1, x_2 \geq 0$

Solution:-

$\frac{1}{2}x_1 + \frac{1}{4}x_2 + S_1 = 4$

$x_1 + 3x_2 - S_2 + a_1 = 20$

$x_1 + x_2 + a_2 = 10$

Step # 2:-

Set the objective function equal to zero.

$z = -2x_1 - 3x_2$

$z = -2x_1 - 3x_2 - mA_1 - mA_2$

$z + 2x_1 + 3x_2 + mA_1 + mA_2 = 0$

$2x_1 + 3x_2 + mA_1 + mA_2 + z = 0$

Step # 3 = Create a simple table.

	x_1	x_2	S_1	S_2	a_1	a_2	z	
$\rightarrow R_1$	$\frac{1}{2}$	$\frac{1}{4}$	1	0	0	0	0	4
$\rightarrow R_2$	1	3	0	−1	1	0	0	20
$\rightarrow R_3$	1	1	0	0	0	1	0	10
$\rightarrow R_4$	2	3	0	0	m	m	1	0

$R_4 + (-mR_3)$

$$\begin{array}{cccccccc} 2 & 3 & 0 & 0 & m & m & 1 & 0 \\ -m & -m & 0 & 0 & 0 & -m & 0 & -10m \\ \hline 2-m & 3-m & 0 & 0 & m & 0 & 1 & -10m \end{array}$$

x_1	x_2	s_1	s_2	a_1	a_2	z	
$\frac{1}{2}$	$\frac{1}{4}$	1	0	0	0	0	4
1	3	0	-1	1	0	0	20
1	1	0	0	0	1	0	10
$2-m$	$3-m$	0	0	m	0	1	$-10m$

$R_4 + (-mR_2)$

$$\begin{array}{cccccccc} 2-m & 3-m & 0 & 0 & m & 0 & 1 & -10m \\ -m & -3m & 0 & m & -m & 0 & 0 & -20m \\ \hline 2-2m & 3-4m & 0 & m & 0 & 0 & 1 & -30m \end{array}$$

	x_1	x_2	s_1	s_2	a_1	a_2	z	
s_1	$\frac{1}{2}$	$\frac{1}{4}$	1	0	0	0	0	4
a_1	1	3	0	-1	1	0	0	20
a_2	1	1	0	0	0	1	0	10
z	$2-2m$	$3-4m$	0	m	0	0	1	$-30m$

Step # 4 :-
Select the pivot column & Row

	x_1	x_2	s_1	s_2	a_1	a_2	z	
s_1	1/2	1/4	1	0	0	0	0	4
a_1	1	3	0	-1	1	0	0	20
a_2	1	1	0	0	0	1	0	10
z	2-2m	3-4m	0	m	0	0	1	-30m

Step # 5 :-
Select the pivot Row & column

	x_1	x_2	s_1	s_2	a_1	a_2	z	
s_1	1/2	1/4	1	0	0	0	0	4
a_1	1	3	0	-1	1	0	0	20
a_2	1	1	0	0	0	1	0	10
z	2-2m	3-4m	0	m	0	0	1	-30m

Step # 6 :-
Select the pivot which is the entry in the pivot column & pivot Row.

	x_1	x_2	s_1	s_2	a_1	a_2	z	
s_1	1/2	1/4	1	0	0	0	0	4
a_1	1	3	0	-1	1	0	0	20
a_2	1	1	0	0	0	1	0	10
z	2-2m	3-4m	0	m	0	0	1	-30m

Step #7 :

Perform Row operations to make pivot equal to 1 & the remaining elements in the pivot column equal to zero

Multiply R_2 by $1/3$

	x_1	x_2	S_1	S_2	a_1	a_2	Z	
S_1	2	1	4	0	0	0	0	16
a_1	$1/3$	1	0	$-1/3$	$1/3$	0	0	$20/3$
a_2	1	1	0	0	0	1	0	10
Z	$2-2m$	$3-4m$	0	m	0	0	1	$-3om$

$R_1 + (-1R_2)$

	2	1	4	0	0	0	0	16
	$-1/3$	-1	0	$1/3$	$-1/3$	0	0	$-20/3$
	$5/3$	0	4	$1/3$	$-1/3$	0	0	$28/3$

	x_1	x_2	S_1	S_2	a_1	a_2	Z	
S_1	$5/3$	0	4	$1/3$	$-1/3$	0	0	$28/3$
a_1	$1/3$	1	0	$-1/3$	$1/3$	0	0	$20/3$
a_2	1	1	0	0	0	1	0	10
Z	$2-2m$	$3-4m$	0	m	0	0	1	$-3om$

$R_3 + (-1R_2)$

	1	1	0	0	0	1	0	10
	$-1/3$	-1	0	$1/3$	$-1/3$	0	0	$-20/3$
	$2/3$	0	0	$1/3$	$-1/3$	1	0	$10/3$

	x_1	x_2	s_1	s_2	a_1	a_2	z	
s_1	5/3	0	4	1/3	-1/3	0	0	28/3
a_1	1/3	1	0	-1/3	1/3	0	0	20/3
a_2	2/3	0	0	1/3	-1/3	1	0	10/3
z	2-2m	3-4m	0	m	0	0	1	-3m

$R_4 + (-3-4m\ R_2)$

2-2m	3-4m	0	m	0	0	1	-3m
-1+4m	-3+4m	0	1-4m	1+4m	0	0	-10+80m
1+2m	0	0	1-3m	1+4m	0	1	-10+50m

Step # 8

	x_1	x_2	s_1	s_2	a_1	a_2	z	
x_2	5/3	0	4	1/3	-1/3	0	0	28/3
s_1	1/3	1	0	-1/3	1/3	0	0	20/3
a_2	2/3	0	0	1/3	-1/3	1	0	10/3
z	1+2m	0	0	1-3m	1+4m	0	1	-10+50m

Step # 8:-

Repeat the addition process by the most.

$x_2 = 28/3$
$s_1 = 20/3$
$a_2 = 10/3$
$z = -10 + 50m$

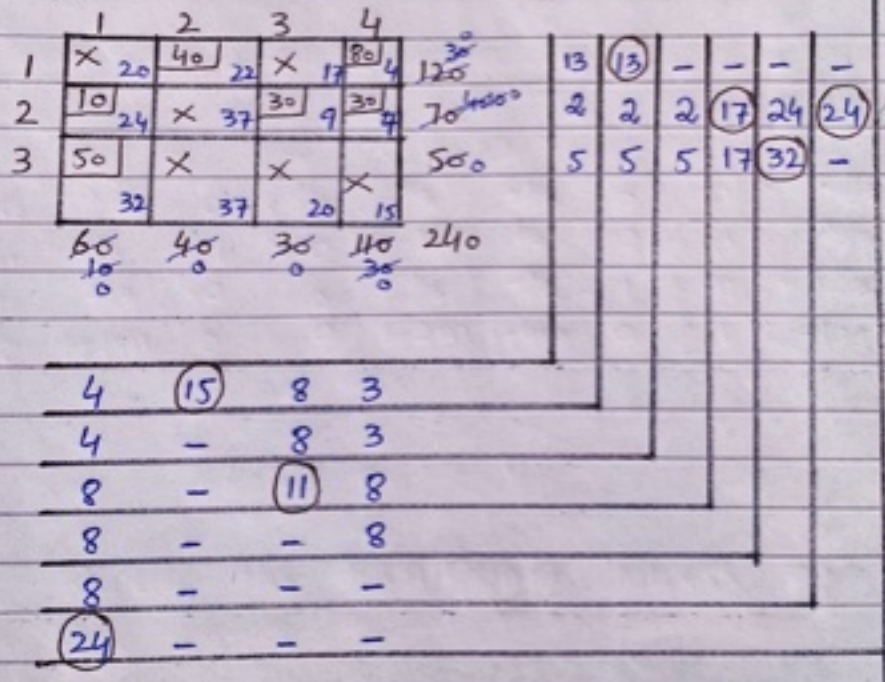
Ans:-

Question # 3

Use Vogel's approximation Method to obtain the initial feasible solution of :-

origin	1	2	3	4	Supply
1	20	22	17	4	120
2	24	37	9	7	70
3	32	37	20	15	50
Demand	60	40	30	110	240

Solution :-



Total Cost :- $40 \times 22 + 80 \times 4 + 10 \times 24 + 30 \times 9 + 30 \times 7 + 50 \times 32$

$= 880 + 320 + 240 + 270 + 210 + 1600 = \boxed{3520}$

Total cost = **3520** Ans:-