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Section : B

Paper : operation Research

Semester : 4th

Class Timing: (WED : 8=11)

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Question#1

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

⇒ **Solution:-**

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

→ **Step#1:-** Row minimization-

JOBS	Machines					Row-Min↓
	A	B	C	D	E	
1	6	12	3	11	15	3
2	4	2	7	1	10	1
3	8	11	10	7	11	7
4	16	19	122	23	21	16
5	9	5	7	6	10	5

→ Step#2 :- Row Subtraction.

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

→ Step#3 :- column minimize.

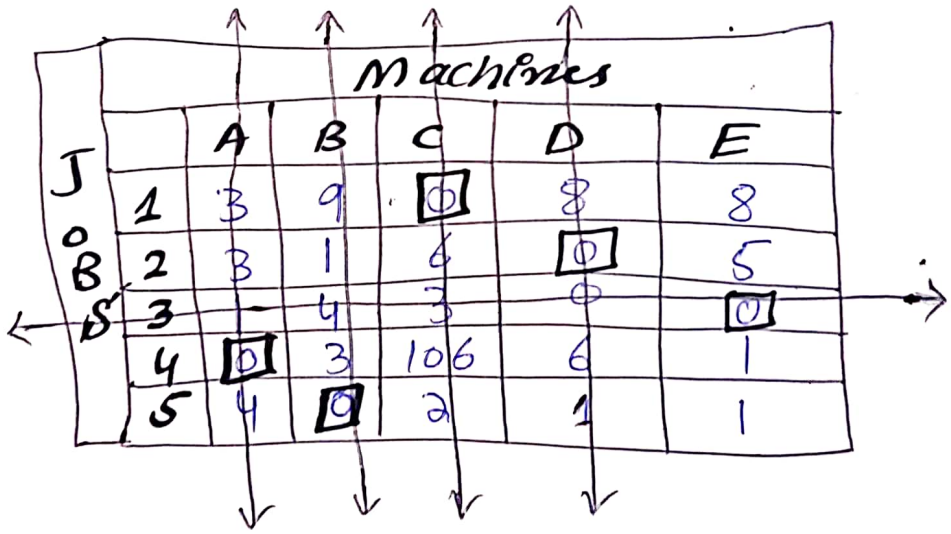
JOBS	Machines				
	A	B	C	D	E
1	3	9	0	8	12
2	3	1	6	0	9
3	1	4	3	0	4
4	0	3	106	6	5
5	4	0	2	1	5
Column min →	0	0	0	0	4

③

→ Step#4:- column Subtraction.

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

→ Step#5:- Draw Horizintal and vertical line through circles.



Hence 5 = 5

optimal solution.

(P.t.o)

(4) → Step#6:- Timing.

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

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

Total processing Time = 36 cmts

(5)

Question#2

Solve the following linear programming problem

$$\text{Min } Z = 2x_1 + 3x_2$$

Subject to:-

$$(1/2)x_1 + (1/4)x_2 \leq 4$$
$$x_1 + 3x_2 \geq 20$$
$$x_1 + x_2 = 10$$
$$x_1, x_2 \geq 0$$

⇒ Solution:-

→ Step#1:-

↳ convert the system of inequalities to equality using slack variable, Artificial and surplus variable.

$$(1/2)x_1 + (1/4)x_2 + S_1 = 4$$
$$x_1 + 3x_2 - S_2 + a_1 = 20$$
$$x_1 + x_2 + a_2 = 10$$

→ Step#2:-

Set the objective function equal to zero.

$$Z = 2x_1 + 3x_2 + Ma_1 + Ma_2 = 0$$

⑥

→ Step#3:- create a simple table ...

Z	x_1	x_2	s_1	s_2	a_1	a_2	
1	-2	-3	0	0	-M	-M	0
0	1/2	1/4	1	0	0	0	4
0	1	3	0	-1	1	0	20
0	1	1	0	0	0	1	10

$(MR_3 + R_1)$

↓

Z	x_1	x_2	S_1	S_2	a_1	a_2	
1	M-2	3M-3	0	-M	0	-M	20M
0	1/2	1/4	1	0	0	0	4
0	1	3	0	-1	1	0	20
0	1	1	0	0	0	1	10

↓ $(MR_4 + R_1)$

Z	x_1	x_2	S_1	S_2	a_1	a_2	
1	2m-2	4m-3	0	-M	0	0	30M
0	1/2	1/4	1	0	0	0	4
0	1	3	0	-1	1	0	20
0	1	1	0	0	0	1	10

(7)

→ Step#4:- Select pavoit column.

Z	x_1	x_2	S_1	S_2	a_1	a_2	
1	2m-2	4m-3	0	-M	0	0	30M =
0	1/2	1/4	1	0	0	0	4
0	1	3	0	-1	1	0	20
0	1	1	0	0	0	1	10

→ Step#5 Select pavoit Row.

Z	x_1	x_2	S_1	S_2	a_1	a_2	
1	2m-2	4m-3	0	-M	0	0	30M = 30M
0	1/2	1/4	1	0	0	0	4 = 80·5
0	1	3	0	-1	1	0	20 = 7·5
0	1	1	0	0	0	1	10

→ Step#6:- Select the pavoit value.

Z	x_1	x_2	S_1	S_2	a_1	a_2	
1	2m-2	4m-3	0	-M	0	0	30M
0	1/2	1/4	1	0	0	0	10·5
0	1	3	0	-1	1	0	7·5
0	1	1	0	0	0	1	10

(8)

→ **Step #3:-** perform the Row operation.

$\frac{1}{3} R_3$ ↓

Z	x_1	x_2	S_1	S_2	a_1	a_2	
1	2m-2	4m-2	0	-M	0	0	3cm
0	1/2	1/4	1	0	0	0	4
0	1/3	(1)	0	-1/3	1/3	0	20/5
0	1	1	0	0	0	1	10

$1R_3 + R_4$ ↓

Z	x_1	x_2	S_1	S_2	a_1	a_2	
1	2m-3	4m-3	0	-M	0	0	3cm
0	5/2	1/4	1	0	0	0	4
0	1/3	1	0	-1/2	3	0	20/2
0	2/3	0	0	1/3	-1/3	1	10/3

$-\frac{1}{4} R_3 + R_2$ ↓

Z	x_1	x_2	S_1	S_2	a_1	a_2	
1	2m-2	4m-3	0	-M	0	0	3cm
0	5/2	0	1	1/2	-1/2	0	7/3
0	1/3	1	0	-1/3	1/3	0	20/3
0	2/3	0	0	1/3	-1/3	1	10/3

(9)

$(-4M+3)R3+R1$ ↓

Z	x_1	x_2	S_1	S_2	a_1	a_2	
1	$(2M-3)/3$	0	0	$(M-3)/3$	$(3-4M)/3$	0	$(60+10M)/3$
0	1/12	0	1	1/12	-1/12	0	$7/3 = 50$
0	1/3	1	0	-1/3	1/3	0	$\frac{20}{3} = 20$
0	2/3	0	0	1/3	-1/3	1	$\frac{10}{5} = 5$

$(3/2)R4$ ↓

Z	x_1	x_2	S_1	S_2	a_1	a_2	
1	$\frac{2}{3}M-1$	0	0	$\frac{1}{3}M-1$	$1-\frac{4}{3}M$	0	$\frac{20+10M}{3}$
0	5/12	0	1	1/12	-1/12	0	7/3
0	1/3	1	0	-1/3	1/3	0	20/3
0	1	0	0	1/2	-1/2	3/2	5

$(-\frac{2}{3}M+1)(R4+R1)$ ↓

Z	x_1	x_2	S_1	S_2	a_1	a_2	
1	0	0	0	-1/2	$(1/2-M)$	$(3/2-M)$	25
0	5/12	0	1	1/12	-1/12	0	7/3
0	1/3	1	0	-1/3	1/3	0	20/3
0	1	0	0	1/2	-1/2	3/2	5

(10)

$$\left(-\frac{5}{12}\right)R_4 + R_2$$

Z	x_1	x_2	S_1	S_2	a_1	a_2	
1	0	0	0	$-1/2$	$(1/2 - m)$	$(\frac{2}{2} - m)$	25
0	0	0	1	$-1/8$	$1/8$	$-5/8$	$1/4$
0	$1/3$	1	0	$-1/3$	$1/3$	0	$20/9$
0	1	0	0	$1/2$	$-1/2$	$3/2$	5

$$\left(-\frac{1}{3}R_4 + R_3\right)$$

~~Z~~	x_1	x_2	S_1	S_2	a_1	a_2	
1	0	0	0	$-1/2$	$(1/2 - m)$	$(\frac{2}{2} - m)$	25
0	0	0	1	$-1/8$	$1/8$	$-5/8$	$1/4$
0	$1/3$	1	0	$-1/3$	$1/3$	0	$20/3$
0	1	0	0	$1/2$	$-1/2$	$3/2$	5

→ **Step#8 :**

$Z = 25$ $\quad x_2 = 5$ $\quad a_1 = 0$

$x_1 = 5$ $\quad S_1 = 1/4$ $\quad a_2 = 0$

$a_3 = 0$

Question #3

Use Vogel's Approximation Method to obtain the initial fessible solution of

origin	Destination 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 :-**

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

Demand = Supply

(Balance transportation problem)

(P.T.O)

(12)

origin	Destination 1	2	3	4	Supply
1	X 20	40 22	X 17	80 4	120 80 0
2	40 24	37	30 9	7	70 40 0
3	20 32	37	20 X	30 15	50 20 0
Demand	60 20	40 0	30 0	110 30 0	240 240

13 (13) – – –
2 2 2 17 17
5 5 5 (17) (17)

4 (15) 8 3
4 – 8 3
8 – (11) 8
(8) – – 8

Total cost = 40(22) + 80(4) + 40(24) + 30(9) + 20(32) + 30(15)

= 880 + 320 + 960 + 270 + 640 + 450

= 3520 Answer