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Class = Software engineering
Semester = 4th
Classday = Thursday

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Q1:- There are total of 5 machines and 5 employment are to be relegated and the relate cost network is as per the following Locate the best possible task-

Sol:-

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

Row Reduction:

Jobs	Machines 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

By subtracting Min Entry from each Row

	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	7	5
5	4	0	2	1	5

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Coloumn Reduction

Jobs	A	B	C	D	E
1	3	9	0	8	12
2	3	1	6	0	9
3	1	4	3	6	4
4	0	3	106	7	5
5	4	0	2	1	5
	0	0	0	0	4

By subtract min entry from each coloumn.

Jobs	1	2	3	4	5
1	3	9	0	8	8
2	3	1	6	0	5
3	1	4	3	0	0
4	0	3	106	7	1
5	4	0	2	1	1

Row Scaning :-

	1	2	3	4	5
1	3	9	0	8	8
2	3	1	6	0	5
3	1	4	3	0	0
4	0	3	106	7	1
5	4	0	2	1	1

Jobs	operator	Time
1	3	3
2	4	1
3	5	11
4	1	16
5	2	5

Total = ~~45 hour~~ 36 hour.

Q2:- Solve the following Linear Programming Problem.

$$\min z = 2x_1 + 3x_2$$

$$\text{S.t} \quad (1/2)x_1 + 1/4\,x_2 \leq 4$$
$$x_1 + 3x_2 \geq 20$$
$$x_1 + x_2 = 10$$
$$x_1, x_2 \geq 0$$

Sol:- $(1/2)x_1 + (1/4)x_2 + s_1 = 4$

Bring equility in constraints.

$$x_1 + 3x_2 - s_1 + a_1 = 20$$
$$x_1 + x_2 + a_2 = 10$$
$$z = -2x_1 - 3x_2$$
$$z = -2x_1 - 3x_2 - mA_1 - mA_2$$
$$z + 2x_1 + 3x_2 + 3x_2 + mA_1 + mA_2 = 0$$
$$2x_1 + 3x_2 + mA_1 + mA_2 + z = 0$$

x_1	x_2	s_1	s_2	a_1	a_2	z	
1/2	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	3	0	0	m	m	1	0

Adding $-mR_3$ to R_4

x_1	x_2	s_1	s_2	a_1	a_2	z	
1/2	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	$-10m$

$R_4 + (-mR_3)$

Now Adding $-mR_2$ to R_4

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	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
$R_4+(-mR_2)$	$2-2m$	$3-4m$	0	m	m	0	1	~~$-30m$~~ $-30m$

Select Pivot Row Pivot Column and Pivot

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
$2-2m$	$3-4m$	0	m	0	0	1	$-30m$

x_1 x_2 s_1 s_2 a_1 a_2 z

Xing R_1 by 4

2	1	4	0	0	0	0	16
1	3	0	-1	1	0	0	20
1	1	0	0	0	1	0	10
$2-2m$	$3-4m$	0	m	0	0	1	$-30m$

x_1 x_2 s_1 s_2 a_1 a_2 z

$\frac{1}{3}R_2$

2	1	4	0	0	0	0	16
$\frac{1}{3}$	1	0	$-\frac{1}{3}$	$\frac{1}{3}$	0	0	$\frac{20}{3}$
1	1	0	0	0	1	0	10
$2-2m$	$3-4m$	0	m	0	0	1	$-30m$

	x_1	x_2	S_1	S_2	a_1	a_2	Z	
$R_1+(-1R_2)$	$5/3$	0	4	$1/3$	$-1/3$	0	0	$28/3$
	$1/3$	1	0	$-1/3$	$1/3$	0	0	$20/3$
	1	1	0	0	0	1	0	10
	$2-2m$	$3-4m$	0	m	0	0	1	$-30m$

	x_1	x_2	S_1	S_2	a_1	a_2	Z	
$R_1+(-1R_2)$	$5/3$	0	4	$1/3$	$-1/3$	0	0	$28/3$
	$1/3$	1	0	$-1/3$	$1/3$	0	0	$20/3$
	1	1	0	0	0	1	0	10
	$2-2m$	$3-4m$	0	m	0	0	1	-30

	x_1	x_2	S_1	S_2	a_1	a_2	Z	
	$5/3$	0	4	$1/3$	$-1/3$	0	0	$28/3$
	$1/3$	1	0	$-1/3$	$1/3$	0	0	$20/3$
$R_3+(-1R_2)$	$2/3$	0	0	$1/3$	$-1/3$	1	0	$10/3$
	$2-2m$	$3-4m$	0	m	0	0	1	$-30m$

	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	$10/3$
~~R_4+R_1~~								
$2R_4(-(3-4m)R_2)$	$1+2m$	0	0	$1-3m$	$-1+4m$	0	1	-10

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	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	$-10+5m$

$x_2 = 28/3$

$s_1 = 20/3$

$a_2 = 10/3$ Ans.

Q3:- Use vogel's Approximation Method to obtain the initial feasible solution of:

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

	A	B	C	D	supply
	20	22	17	4	120
	24	37	9	7	70
	32	37	20	15	50
Demand	60	40	30	110	240

Demand = supply

Hence it is a balanced transportation problem

	A	B	C	D	supply				
S_1	~~20~~	40 22	~~17~~	80 4	~~80~~ 0	13	13	-	-
S_2	10 24	~~37~~	30 9	30 7	~~10~~ ~~40~~ 0 ~~70~~	2	2	2	17
S_3	50 32	~~37~~	~~20~~	~~15~~		5	5	5	17
Demand	~~60~~ 50	~~40~~ 0	~~30~~ 0	~~110~~ 30 0					

4 15 8 3

4 - 8 3

8 - 11 8

8 - - 8

Total cost = 40(22) + 80(4) + 10(24) + 30(9) + 30(7) + 50(32)

Total cost = 3520 Ans.