O.P.Code: 23HS0852	R23	H.T.No.										

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR
(AUTONOMOUS)
B.Tech. II Year II Semester Regular Examinations July/August-2025
OPTIMIZATION TECHNIQUES
(Common to CAI, CSM & CSIT)

Time: 3 Hours **Max. Marks: 70**

PART-A

(Answer all the Questions **10 x 2 = 20** Marks)

1	a	Define Standard form of LPP.	CO1	L1	2M
	b	Define Slack and Surplus Variable.	CO1	L1	2M
	c	What is an Degeneracy Transportation Problem.	CO2	L1	2M
	d	What is mean by Unbalanced in Assignment Problem.	CO2	L1	2M
	e	Define sequencing.	CO3	L1	2M
	f	Write assumptions of sequencing.	CO4	L1	2M
	g	Define Saddle point.	CO5	L1	2M
	h	Define Payoff matrix.	CO5	L1	2M
	i	Define Total float.	CO6	L1	2M
	j	Define Pessimistic time.	CO6	L1	2M

PART-B

(Answer all Five Units **5 x 10 = 50** Marks)

UNIT-I

2 Solve the following Linear Programming Problem using Graphical method. Maximixe **CO1 L3 10M**

$$z = 6x_1 + 8x_2$$

Sub. to

$$x_1 + x_2 \geq 6$$
$$7x_1 + x_2 \geq 14$$
$$x_1, x_2 \geq 0$$

OR

3 Solve the following Linear Programming Problem using Big-M method. Maximize **CO1 L3 10M**

$$z = 6x_1 + 4x_2$$

Sub. to

$$2x_1 + 3x_2 \leq 30$$
$$3x_1 + 2x_2 \leq 24$$
$$x_1 + x_2 \geq 3$$
$$x_1, x_2 \geq 0$$

UNIT-II

4 a Obtain the initial basic feasible solution by using VAM to the following Transportation Problem **CO2 L5 5M**

	D_1	D_2	D_3	D_4	Supply
O_1	3	1	7	4	300
O_2	2	6	5	9	400
O_3	8	3	3	2	500
Demand	250	350	400	200	

b	A company has four salesman targeted at four cities.the profit per day in rupees for each salesman in each city is given below. find the assignment of salesman to various cities which maximses the total profit	CO2	L5	5M

		SALESMAN			
		1	2	3	4
CITIES	A	16	10	14	11
	B	14	11	15	15
	C	15	15	13	12
	D	13	12	14	15

OR

5	Solve the following Transportation Problem	CO2	L3	10M

	D_1	D_2	D_3	D_4	Available
O_1	8	10	7	6	50
O_2	12	9	4	7	40
O_3	9	11	10	8	30
Require	25	32	40	23	

UNIT-III

6	We have five jobs,each of which must go through two machines A and B in the order AB.Processing the times(in hours) are givn below	CO3	L5	10M

JOBS	1	2	3	4	5
MACHINE A	5	1	9	3	10
MACHINE B	2	2	7	8	4

OR

7	Four jobs are to be processed on each of the 5 machines find the total minimum elapsed time if no passing of jobs is permitted also find the idle time for each machine.	CO4	L5	10M

MACHINE	JOBS			
	1	2	3	4
A	7	6	5	8
B	5	6	4	3
C	2	4	5	3
D	3	5	6	2
E	9	10	8	6

UNIT-IV

8	a	Determine the optimal strategy for company A and company B	CO5	L1	5M

Company B

$$\text{Company A} \begin{bmatrix} 20 & 15 & 22 \\ 35 & 45 & 40 \\ 18 & 20 & 25 \end{bmatrix}$$

b Consider the given payoff matrix with respect to player A and solve it Optimally CO5 L1 5M

$$\begin{array}{cc} & \text{Player B} \\ \text{Player A} & \begin{bmatrix} 6 & 9 \\ 8 & 4 \end{bmatrix} \end{array}$$

OR

9 Consider the payoff matrix of player A and slove it optimally using graphical method CO5 L5 10M

		Player B				
		1	2	3	4	5
Player A	1	3	0	6	-1	7
	2	-1	5	-2	2	1

UNIT-V

10 Consider the following data for the activities of a project CO6 L5 10M

Activity	A	B	C	D	E	F	G	H	I	J
Immediate predecessor	-	-	A	B	B	B	C,D	E,I	F	F
Duration (Weeks)	5	4	8	8	8	5	8	22	2	12

OR

11 A Project consists the following activities and Different Estimate times CO6 L5 10M

Activity	Optimisti time	Mostlikely time	pessimistic time
1-2	1	1	13
1-6	2	5	14
2-3	2	14	26
2-4	2	5	8
3-5	7	10	19
4-5	5	5	17
6-7	5	8	29
5-8	3	3	9
7-8	8	17	32

Draw the project network and find probability of the project completing in 40 days

*** END ***

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY: PUTTUR

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Siddharth Nagar, Narayanavanam Road, PUTTUR-517 583

EXAMINATION BRANCH

Scheme of Evaluation

Name of the Examination	: II Year II Sem R23 Reg July/August 2025
Name of the Subject	: **OPTIMIZATION TECHNIQUES**
Max. Marks	: 70
Subject Code & Regulation	: 23HS0852 & R23

Question No.		Detailed Step by Step Procedure	Step wise marks division
		PART-A	
1	a.	A linear programming problem (LPP) is in standard form when it seeks to maximize an objective function subject to linear constraints with non-negative variable Example:- Max $z = 3x+2y$ / Sub to $x+y<=5$	2M
	b.	Slack variable is added to S, '<=' constraint Surplus variable is subtract to S, '>=' constraint	2M
	c	Degeneracy occurs when number of Allocations $< m+n-1$ (m=rows, n=columns) (No. of Allocations $\neq m+n-1$)	2M
	d	If number of Jobs ≠ Number of persons it's unbalanced. Dummy row/column are added to balance Example : 4 worker's, 5 Jobs → add dummy worker	2M

	e	sequencing determines the order of jobs on machines for optimal processing	2M
	f	* Jobs are independent * processing times known * setup times negligible * one job per machine	2M
	g	Saddle point is an element in a payoff matrix where maximin = minimax	2M
	h	Matrix showing outcomes for each players strategies Player A $\begin{array}{c\|cccccc} & B_1 & B_2 & \cdots B_j & \cdots & B_n \\ \hline A_1 & a_{11} & a_{12} & \cdots a_{1j} & \cdots & a_{1n} \\ A_2 & a_{21} & a_{22} & \cdots a_{2j} & \cdots & a_{2n} \\ A_i & a_{i1} & a_{i2} & \cdots a_{ij} & \cdots & a_{in} \\ A_m & a_{m1} & a_{m2} & \cdots a_{mj} & \cdots & a_{mn} \end{array}$	2M
	i	Total float is the delay in an activity with affecting the early start of the next activity	2M
	j	pessimistic time (t_p) is the maximum time required for an activity	2M

	PART-B	
	UNIT-I	
2	Max $z = 6x_1 + 8x_2$ Sub to $x_1 + x_2 \geq 6$ $7x_1 + x_2 \geq 14$ $x_1, x_2 \geq 0$ $x_1 + x_2 = 6 \rightarrow (1)$ $7x_1 + x_2 = 14 \rightarrow (2)$ In Eq (1) $x_1 = 0 \Rightarrow x_2 = 6 \rightarrow (0, 6)$ $x_2 = 0 \Rightarrow x_1 = 6 \rightarrow (6, 0)$ In Eq (2) $x_1 = 0 \Rightarrow x_2 = 14 \rightarrow (0, 14)$ $x_2 = 0 \Rightarrow x_1 = 2 \rightarrow (2, 0)$	3M
	By solving the Eq (1) and Eq (2) $x_1 = 4/3$ and $x_2 = 14/3$ In Graph point of intersection $= (4/3, 14/3)$ The optimum solution will be in any one of the corner points B, C and D Max $z = 6(0) + 8(14) = 112$ Max $z = 6(4/3) + 8(14/3) = 45.28$ Max $z = 6(6) + 3(0) = 36$	4M
	The max z value is the corner point $x_1 = 0$ and $x_2 = 14$ maximum value of $z = 112$ At point $(0, 14)$	3M
	OR	

$\text{Max } z = 6x_1 + 4x_2 + 0S_1 + 0S_2 + 0S_3 - MA$

Subject to

$2x_1 + 3x_2 + S_1 = 30 \ ; \ 3x_1 + 2x_2 + S_2 = 24 \ ; \ x_1 + x_2 - S_3 + A = 3$

Iteration 1 : $x_1, x_2, S_1, S_2, S_3, A \geq 0$

CB	XB	c_j / Sol	6 x_1	4 x_2	0 S_1	0 S_2	0 S_3	$-M$ A	Ratio
0	S_1	30	2	3	1	0	0	0	15
0	S_2	24	3	2	0	1	0	0	8
$-M$	A	3	1	1	0	0	-1	1	3 →
	z_j	$-3M$	$-M$	$-M$	0	0	M	$-M$	
	$z_j - c_j$		$-M-6$ ↑	$-M-4$	0	0	M	0	

3M

Iteration 2 :

CB	XB	c_j / Sol	6 x_1	4 x_2	0 S_1	0 S_2	0 S_3	$-M$ A	Ratio
0	S_1	24	0	1	1	0	2	-2	22
0	S_2	15	0	-1	0	1	3	-3	5 →
6	x_1	3	1	1	0	0	-1	1	-3
	z_j	18	6	6	0	0	-6	6	
	$z_j - c_j$		0	2	0	0	-6 ↑	$6+M$	

3M

Iteration 3 :

CB	XB	c_j / Sol	6 x_1	4 x_2	0 S_1	0 S_2	0 S_3	$-M$ A	Ratio
0	S_1	34	0	5/3	1	$-2/3$	0	0	
0	S_3	5	0	$-1/3$	0	1/3	1	-1	
6	x_1	8	1	2/3	0	1/3	0	0	
	z_j	48	6	4	0	2	0	0	
	$z_j - c_j$		0	0	0	2	0	M	

3M

Here all $z_j - c_j \geq 0$

The optimum solution for given LPP $x_1 = 8 \ ; \ x_2 = 0$ 1M

$\text{Max}(z) = 6x_1 + 4(x_2) = 6(8) + 0 = 48$

		UNIT-II	
4	a.	Given 		1	2	3	4	Supply
---	---	---	---	---	---
I	3	1	7	4	300
II	2	6	5	9	400
III	8	3	3	2	500
Demand	250	350	400	200	| To obtain initial basic feasible solution by using VAM (penalties find after) |			
3	[300] 1	7	4
[250] 2	6	[150] 5	9
8	[50] 3	[250] 3	[200] 2	 $x_{12} = 300$ $x_{21} = 250$ $x_{23} = 150$ $x_{32} = 50$ $x_{33} = 250$ $x_{34} = 200$ $1 \times 300 + 2 \times 250 + 5 \times 150 + 3 \times 50 + 3 \times 250 + 2 \times 200$ $= 2850$	3M 2M
	b.	The Given Assignment problem maximum value 16 So, we reduce the 16 to the elements	1M

Given

$$\begin{array}{cc} & \text{Salesman} \\ & \begin{array}{cccc} 1 & 2 & 3 & 4 \end{array} \\ \text{Cites} \begin{array}{c} A \\ B \\ C \\ D \end{array} & \begin{bmatrix} 16 & 10 & 14 & 11 \\ 14 & 11 & 15 & 15 \\ 15 & 15 & 13 & 12 \\ 13 & 12 & 14 & 15 \end{bmatrix} \end{array}$$

$$\begin{bmatrix} 0 & 6 & 2 & 5 \\ 2 & 5 & 1 & 1 \\ 1 & 1 & 3 & 4 \\ 3 & 4 & 2 & 1 \end{bmatrix}$$

3M

Row Reduction

$$\begin{bmatrix} 0 & 6 & 2 & 5 \\ 1 & 4 & 0 & 0 \\ 0 & 0 & 2 & 3 \\ 2 & 3 & 1 & 0 \end{bmatrix}$$

colum reduction

$$\begin{bmatrix} \boxed{0} & 6 & 2 & 5 \\ 0 & 4 & \boxed{0} & 0 \\ 0 & \boxed{0} & 2 & 3 \\ 2 & 3 & 1 & \boxed{0} \end{bmatrix}$$

The Assignment cost

$16+15+15+15=61$ 1M

OR

5 Obtaining initial Basic feasible Solution by VAM

8	10	7	6	50	(1)
12	9	4 $\boxed{40}$	7	~~40~~ 0	(3) ✓
9	11	10	8	30	(1)
25	32	~~40~~	23		
(1)	(1)	(3)	(1)		

$[x_{23} = 40]$

2M

8	10	6 $\boxed{23}$	~~50~~ 27	(2) ✓
12	9	7	0	(2)
9	11	8	30	(1)
25	32	~~23~~		
(1)	(1)	(1)		

$[x_{14} = 23]$

8	10	27	(2)
12	9 $\boxed{0}$	0	(3) ✓
9	11	30	(2)
25	32		
(1)	(1)		

$[x_{22} = 0]$

1M

8 $\boxed{25}$	10	$\cancel{27}$ 2 (2)
9	11	30 (2)
25 (1)	32 (1)	

[$x_{11} = 25$]

10 $\boxed{2}$	2
11 $\boxed{30}$	30
32	

[$x_{12} = 2$, $x_{32} = 30$]

2M

<u>find an optimum solution</u>

	D1	D2	D3	D4	
O1	8 $\boxed{25}$	10 $\boxed{2}$	7 $\boxed{\varepsilon}$	6 $\boxed{23}$	$u_1 = 0$
O2	12	9 $\boxed{40}$	4	7	$u_2 = -3$
O3	9	11 $\boxed{30}$	10	8	$u_3 = 1$
	$v_1 = 8$	$v_2 = 10$	$v_3 = 7$	$v_4 = 6$	

3M

The number of basic cells are $5 < m+n-1$ $(4+3-1) = 6$ This is a problem of degeneracy in The Transportation problem

Introduce a small positive quantity $\varepsilon (\to 0)$ in the non-basic cell $(1, 3)$

To Calculate Net Evaluation Non basic cell

2M

$x_{21} = -7$, $x_{22} = -2$, $x_{24} = -4$, $x_{32} = -2$

$x_{44} = -1$, $x_{24} = -4$

$\therefore \; z_j - c_j \le 0$

All are statisfied

$(25 \times 8) + (2 \times 10) + (0 \times 7) + (23 \times 6) + (40 \times 4) + (30 \times 11)$
$= 848$

6

The optimal sequence

2	4	3	5	1

2M

To Calulate Total elapsed time

Jobs	Machine A			Machine B		
	In	D	out	In	D	out
2	0	1	1	1	2	3
4	1	3	4	4	8	12
3	4	9	13	13	7	19
5	13	10	23	23	4	27
1	23	5	28	28	2	30

4M

∴ The Total elapsed time 30

The Idle time for machine A = 30 − 28
= 2

2M

Idle time for machine B = 1+1+1+3+1
= 7

2M

7

Since the problem is to be sequenced on five machines, we convert the problem into a two-machine problem

$$\min(A) = 5 \qquad \min(E) = 6$$

$$\max(B, C, D) = (6, 5, 6)$$

$$\min(E) \geq \max(6, 5, 6)$$

$$6 \geq 6 \text{ (True)}$$

We define two machines G and H such that

$$G = A + B + C + D$$

$$H = B + C + D + E$$

Jobs	1	2	3	4
G	17	21	20	16
H	19	25	23	14

2M

Optimal sequence

1	3	2	4

1M

Job	Machine A			Machine B			Machine C			Machine D			Machine E		
	IN	D	out	IN	D	out	IN	D	out	In	D	out	In	D	out
1	0	7	7	7	5	12	12	2	14	14	3	17	17	9	26
3	7	5	12	12	4	16	16	5	21	21	6	27	27	8	35
2	12	6	18	18	6	24	24	4	28	28	5	33	35	0	45
4	18	8	26	26	3	29	29	3	32	33	2	35	45	6	51

3M

Total elapsed time $= 51$

Ideal time for machine A $= 25$

Ideal time for machine B $=$

$(51-29)+7+2+2 = 33$ 1M

Ideal time for machine C $=$

$(51-32)+12+2+3+1 = 37$ 1M

Ideal time for machine D $=$

$(51-35)+14+4+1 = 35$ 1M

Ideal Time for machine E $=$

$(51-55)+17+1 = 18$ 1M

1

Unit – IV

8(a)

Company B

$$\begin{array}{c|c|c} & \text{Company A} \begin{bmatrix} 20 & 15 & 22 \\ 35 & 45 & 40 \\ 18 & 20 & 25 \end{bmatrix} & \begin{array}{c} \text{Row min} \\ 15 \\ 35 \\ 18 \end{array} \end{array}$$

column max 35 45 40

Maxmin = Max [15, 35, 18] = 35

Minimax = Min [35, 45, 40] = 35 3M

Maxmin = Minimax

∴ The Saddle point exist

Value of the game V = 35

optimum probability strategy for A = [0, 1, 0]

optimum probability strategy for B = [1, 0, 0] 2M

8(b)

player B

$$\begin{array}{cccc} & 1 & 2 & \text{Row(min)} \\ \text{player A} \quad 1 & 6 & 9 & 6 \\ 2 & 8 & 4 & 4 \end{array}$$

column(max) 8 9

Maxmin = 6

Minmax = 8

Maxmin ≠ Minimax

∴ The Saddle point does not exist 3M

The problem has mixed strategy

$p_1 = \frac{4}{7}$; $p_2 = \frac{3}{7}$; $q_1 = \frac{5}{7}$, $q_2 = \frac{2}{7}$

value of the game $V = \frac{48}{7}$

optimum strategy for player A $= \left(\frac{4}{7}, \frac{3}{7}\right)$

optimum strategy for player B $= \left(\frac{5}{7}, \frac{2}{7}\right)$ 2M

OR

(9) Method I

player B

$$\begin{array}{cc|c} & \begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \end{array} & \text{Row min} \\ \text{player A} \begin{array}{c} 1 \\ 2 \end{array} & \begin{bmatrix} 3 & 0 & 6 & -1 & 7 \\ -1 & 5 & -2 & 2 & 1 \end{bmatrix} & \begin{array}{c} -1 \\ -2 \end{array} \\ \text{column max} & \begin{array}{ccccc} 3 & 5 & 6 & 2 & 7 \end{array} & \end{array}$$

Maxmin $= -1$

Minimax $= 2$

Maxmin $\neq$ Minimax

Game has no saddle point 3M

It has mixed strategy

Table (1)

player B

$$\begin{array}{cc} & \begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \end{array} \\ \text{player A} \begin{array}{c} 1 \\ 2 \end{array} & \begin{bmatrix} 3 & \cancel{0} & 6 & -1 & \cancel{7} \\ -1 & \cancel{5} & -2 & 2 & \cancel{1} \end{bmatrix} \end{array}$$

B_5 is dominated by B_1

$\Rightarrow B_5$ is deleted

B_2 is dominated by B_4

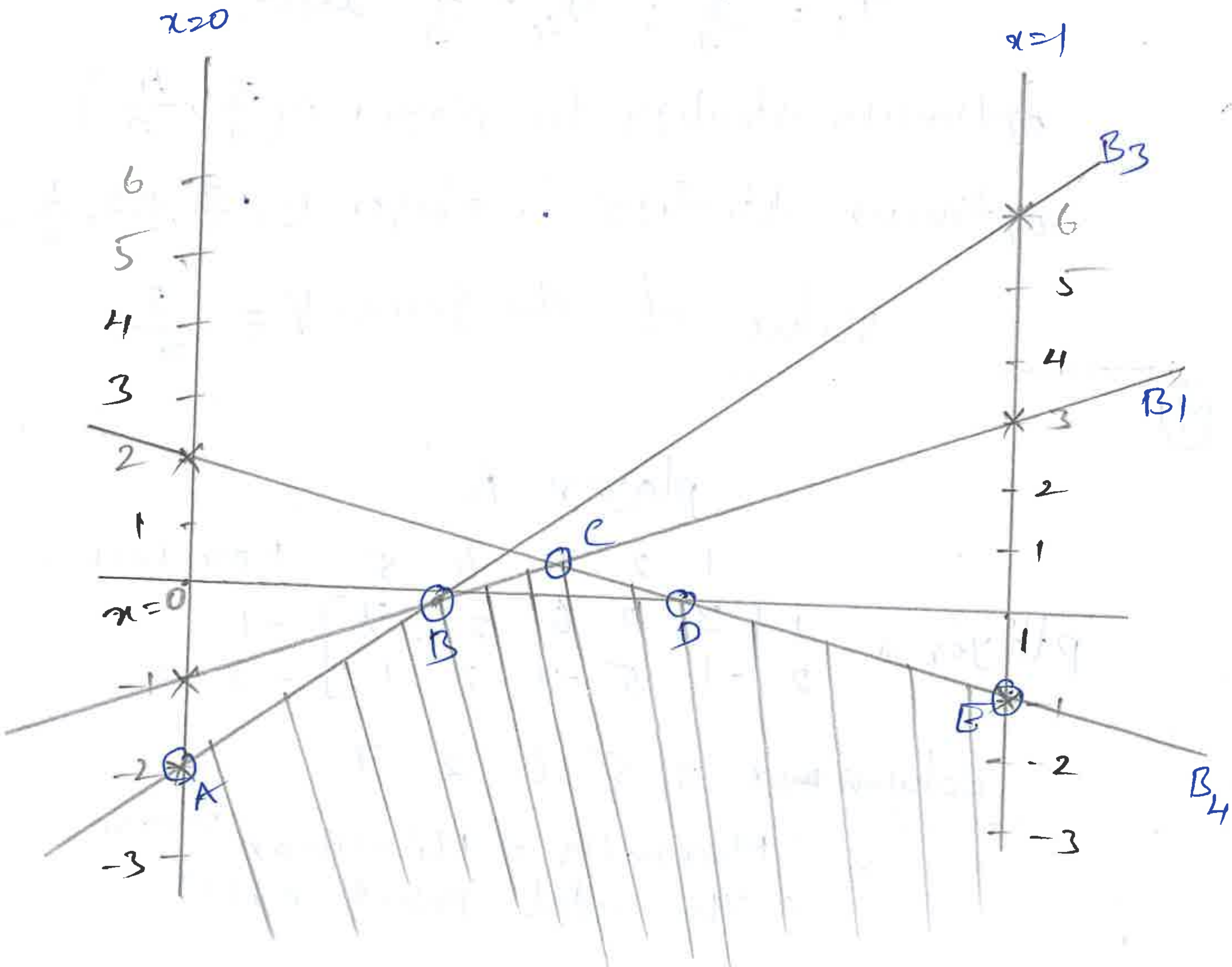
$\rightarrow B_2$ is deleted

Table ②:

$$\begin{array}{cc} & \text{player B} \\ & \begin{array}{ccc} 1 & 3 & 4 \end{array} \\ \text{player A} \begin{array}{c} 1 \\ 2 \end{array} & \begin{bmatrix} 3 & 6 & 1 \\ -1 & -2 & 2 \end{bmatrix} \begin{array}{c} x \\ 1-x \end{array} \end{array}$$

B's Alternative	A's expected payoff functions	A's expected gain	
		$x=0$	$x=1$
1	$3x-1(1-x)=4x-1$	-1	3
3	$6x-2(1-x)=8x-2$	-2	6
4	$-x+2(1-x)=2-3x$	2	-1

3M



Since A is a maximum type of player A
so identity the highest intersection point in the lower boundary of the graph.
'c' is the highest intersection point and c is passing through B_1 & B_4 lines

Table ③

player B

$$\text{player A}\quad \begin{array}{c|cc} & 1 & 4 \\ \hline 1 & 3 & -1 \\ 2 & -1 & 2 \end{array}$$

$P_1 = \frac{3}{7}$; $P_2 = \frac{4}{7}$

$q_1 = \frac{3}{7}$; $q_4 = \frac{4}{7}$ and

optimum strategy for player A $\left(\frac{3}{7}, \frac{4}{7}\right)$ 4M

optimum strategy for player B $\left(\frac{3}{7}, 0, 0, \frac{4}{7}, 0\right)$

Value of the game $V = \frac{5}{7}$

⑨ Method II

player B

	1	2	3	4	5	Row min
player A 1	3	0	6	−1	7	−1
2	−1	5	−2	2	1	−2
column max	3	5	6	2	7	

3M

Maxmin ≠ Minimax
∴ The saddle point exist

By using Graphical method

B's pure strategy	Expected gain player A	Axis-1 $P_1=0$	Axis-2 $P_1=1$
B_1	$E[P] = 3P_1 + (-1)P_2 = 3P_2 - P_1$ $= 3P_1 - 1 + P_1$	-1	3
B_2	$E[P] = 5 - 5P_1$	5	0
B_3	$E[P] = 6P_1 - 2 + 2P_1$	-2	6
B_4	$E[P] = -P_1 + 2P_2 =$ $-P_1 + 2 - 2P_1$	2	-1
B_5	$E[P] = 7P_1 + 1 - P_1$	1	7

3M

By using Graph After pay off matrix is

$$\begin{bmatrix} 3 & -1 \\ -1 & 2 \end{bmatrix}$$

The value of the game $V = \frac{5}{7}$

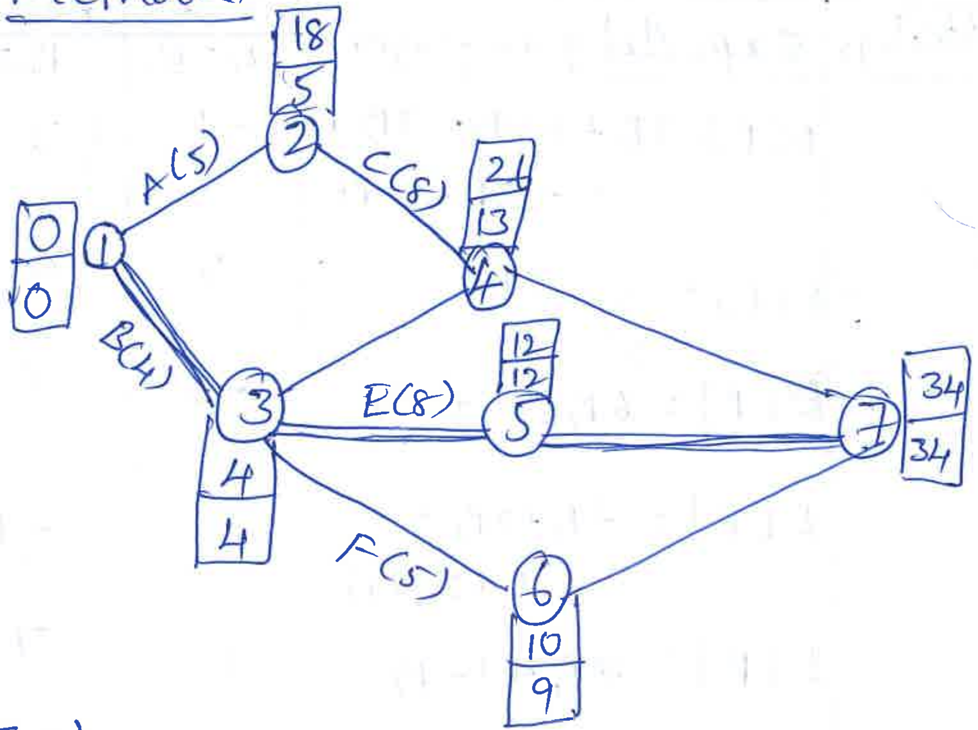
$P_1 = \frac{3}{7}$ $P_2 = \frac{4}{7}$ $q_1 = \frac{3}{7}$ $q_2 = \frac{4}{7}$ 4M

The optimum strategy for player A $(\frac{3}{7}, \frac{4}{7})$

The optimum strategy for player B $(\frac{3}{7}, 0, 0, \frac{4}{7}, 0)$

unit - V

(10) Method I



7M

Table

Activity i-j	$ES_j = \max(ES_i + D_{ij})$	$LC_i = \min(LC_j - D_{ij})$
	$ES_1 = 0$	
1-2	$ES_2 = 0+5 = 5$	$LC_7 = 34$
1-3	$ES_3 = 0+4 = 4$	$LC_6 = 34-12 = 22$
2-4, 3-4	$ES_4 = \{13, 12\} = 12$	$LC_5 = \min\{34-22, 22-2\} = 12$
3-5	$ES_5 = 4+8 = 12$	$LC_4 = 34-8 = 26$
3-6	$ES_6 = 4+5 = 9$	$LC_3 = \min\{22-5, 12-8, 26-8\} = 4$
4-7, 5-7, 6-7	$ES_7 = \max\{9+12, 13+8, 12+22\} = 34$	$LC_2 = 26-8 = 18$
		$LC_1 = 0$

An activity i, j is said to be critical if following conditions are satisfied

(i) $ES_i = LC_i$ (ii) $ES_j = LC_j$ (iii) $ES_j - ES_i =$

$LC_j - LC_i = D_{ij}$

By applying the above conditions to the activity in the figure above, the critical activities are identified and are shown in figure.

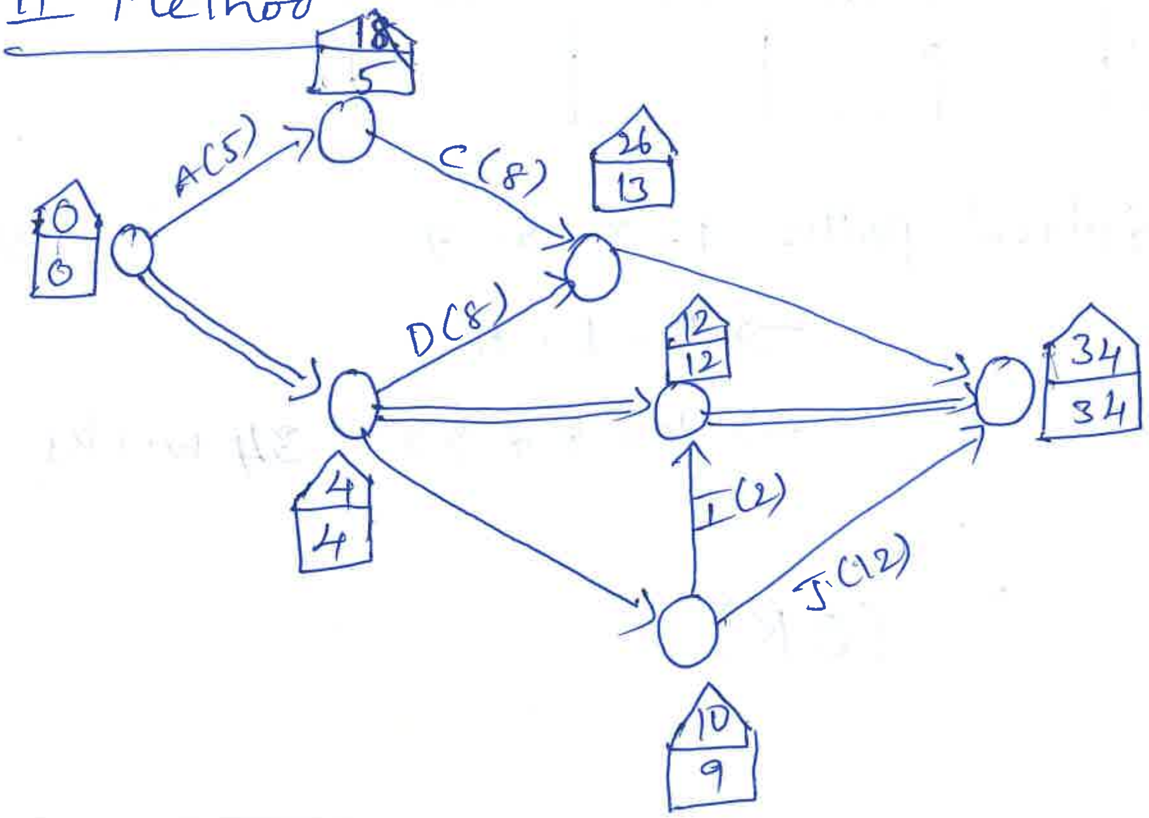
The corresponding critical path is 3M

$CP = 1-3-5-7$

$\rightarrow B - E - H$

$\rightarrow 4 + 8 + 22 = 34$ weeks

II Method



7M

Activity	Time	Earliest		Latest		Total float
		Start	finish	start	finish	
A	5	0	5	13	8	13
B	4	0	4	0	4	$\boxed{0}$
C	8	5	13	18	26	13
D	8	4	13	18	26	14
E	8	4	12	4	12	$\boxed{0}$
F	5	4	9	5	10	1
G	8	13	34	26	34	13
H	22	12	34	12	34	$\boxed{0}$
I	2	9	12	10	12	1
J	12	9	34	22	34	13

Critical path = 1 – 3 – 5 – 7 3M

→ B – E – H

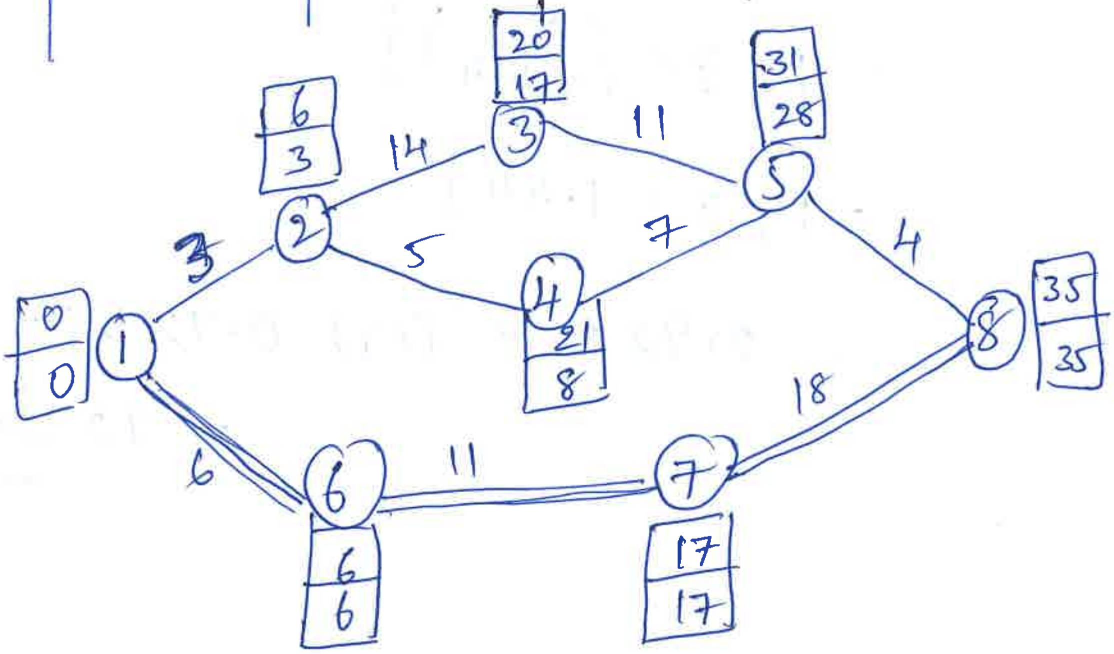
→ 4 + 8 + 22 = 34 weeks

(OR)

(11)

Activity	optimistic time (a)	Most likely time (m)	pesimistic time (b)	Mean $\mu = \frac{a+4m+b}{6}$	Variance $\sigma^2 = \left(\frac{b-a}{6}\right)^2$
1-2	1	1	13	3	4
1-6	2	5	14	6	4
2-3	2	14	26	14	4
2-4	2	5	8	5	1
3-5	7	10	19	11	4
4-5	5	5	17	7	2
6-7	5	8	29	11	4
5-8	3	3	9	4	1
7-8	8	17	32	18	4

4M



4M

Critical path 1-6-7-8

$\rightarrow 6+11+18 = 35$

The sum of the variances of all the activities on the CP is follows

Activity	Mean duration(μ)	variance σ^2
1-6	6	4
6-7	11	4
7-8	18	4
	$\Sigma\mu = 35$	$\Sigma\sigma_i^2 = 12$

$$\Sigma\sigma = \sqrt{12}$$
$$= 3.464$$

probability of project completing in 40 days is

$$P(x \le c) = P\left[\left(\frac{x-\mu}{\sigma}\right) \le \left(\frac{c-\mu}{\sigma}\right)\right]$$

$$= P\left[z \le \left(\frac{40-35}{3.464}\right)\right]$$

2M

$$= P\left[z \le \left(\frac{5}{3.464}\right)\right]$$

$$= P[z \le 1.44]$$

$$= 0.92507 \text{ (or) } 0.92507 \times 100\%$$

$$= 92 \text{ days}$$

Prepared By	**:E LEELAKRISHNA**
Designation	**:ASSISTANT PROFESSOR**
Department	**:MATHEMATICS**
Phone Number	**:8667443910**
E-mail Id	**:enjamleelakrishna@gmail.com**

S.No	List of the Faculty who taught the subject	Signature
1	E. Leelakrishna	Leelakrishna
2	V. Swapna.	V-Swapna

E. Keerthi
Head of the Department

HOD
Dept. of Basic Sciences & Humanities
Siddharth Institute of Engg. & Technology
Narayanavanam Road, Puttur-517583,