JISCE/ODD 2020

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JIS COLLEGE OF ENGINEERING

An Autonomous Institute under MAKAUT, WB

Course: : B. Tech

Stream: : Computer Science & Engineering

Semester / Year : 5th Semester / 3rd Year.

Paper Name: : Operations Research.

Paper Code: : CS 505A

Date of Examination: 2 1 0 1 2 1

University Registration Number

1 8 1 2 3 0 1 1 0 0 9 6 OF 2 0 1 8 - 2 0 2 2

Student Roll Number

1 2 3 1 8 0 7 0 3 0 9 6

Full Signature of the Candidate:

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Signature of Invigilator(s):

Swapna Sarkar

Signature of the COE:

Student's Status

Regular: ●

Backlog: ○

(1)

Group-B

(2) ~~Usin~~

Destinations:

Origin	D_1	D_2	D_3	~~D_4~~ Stock
O_1	4	3	2	10
O_2	1	5	0	13
O_3	3	8	5	12
Demand	8	5	4	

Using Matrix Minima or Least Cost Method →.

Origin	D_1	D_2	D_3	Stock.
O_1	4	3	2	10
O_2	1	5	0	13
O_3	3	8	5	12
Demand.	8	5	4	

Stock ~~Req~~ → 35

Demand → 17

Thus Demand ≠ Stock. hence Unbalanced.

Origin	D_1	D_2	D_3	Dummy (D_4)	Stock.
O_1	4	3	2	$\boxed{0 \; 10}$	~~10~~ - 0
O_2	1	5	0	0	13
O_3	3	8	5	0	12
	8	5	4	~~18~~ 8	35

Origin	D_1	D_2	D_3	D_4	Stock
~~O_1~~					
O_2	1	5	0	$\boxed{0 \; 8}$	~~13~~ 5 ⇒
O_3	3	8	5	0	12
	8	5	4	~~8~~ 0	25

Origin	D_1	D_2	D_3	Stock
O_2	1	5	$\boxed{0 \; 4}$	~~8~~ 1
O_3	3	8	5	12
	8	5	~~4~~ 0	17

Origin	D_1	D_2	Stock
O_2	$\boxed{1 \; 1}$	5	~~1~~ 0
O_3	3	8	12
	~~8~~ 7	5	13

	D_1	D_2	Stock
O_3	3 7	8 5	12
	~~7~~	~~5~~	12

Initial Basic Feasible Solution →

Origin	D_1	D_2	D_3	Dummy (D_4)	Stock
O_1	4	3	2	$\boxed{0 \; 10}$	10
O_2	$\boxed{1 \; 1}$	5	$\boxed{0 \; 4}$	$\boxed{0 \; 8}$	13
O_3	$\boxed{3 \; 7}$	$\boxed{8 \; 5}$	5	0	12
	8	5	4	18	

∴ Transportation cost → $(0 \times 10) + (0 \times 8) + (0 \times 4)$

$+ (1 \times 1) + (3 \times 7) + (8 \times 5)$

$= ₹\, 62$ (Ans)

(3)

(6) $Z = 3x_1 + 4x_2$

$5x_1 + 4x_2 \leq 200$ — (1)

$3x_1 + 5x_2 \leq 150$ — (2)

$5x_1 + 4x_2 \geq 100$ — (3)

$8x_1 + 4x_2 \geq 80$ — (4)

$x_1, x_2 \geq 0$

(1) →

x_1	40	0
x_2	0	50

(2) →

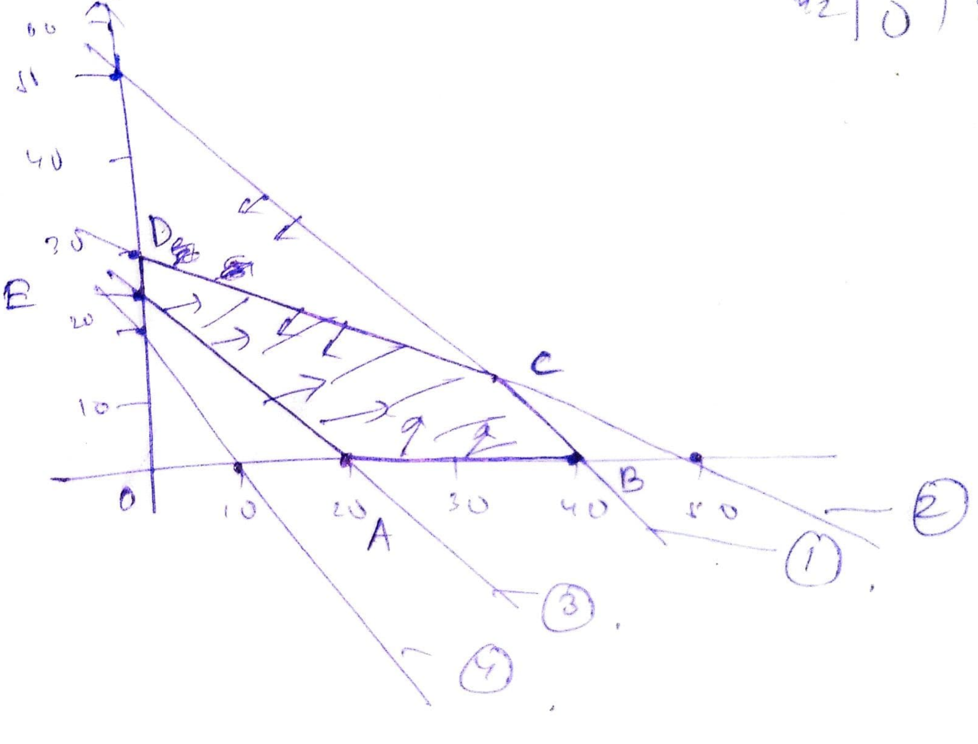
x_1	50	0
x_2	0	30

(3) →

x_1	20	0
x_2	0	25

(4) →

x_1	10	0
x_2	0	20



For 'C →

$5x_1 + 4x_2 = 200$ — (1)

$3x_1 + 5x_2 = 150$ — (2)

Solving (1) and (2) →

$$15x_1 + 12x_2 = 600$$
$$\underline{-15x_1 \; \underline{+} \; 25x_2 = \underline{-}750}$$
$$-13x_2 = -150$$

$$x_2 = \frac{150}{13}$$

∴ eq $5x_1 + 4 \times \frac{150}{13} = 200.$

$$x_1 = \frac{200 - \frac{4 \times 150}{13}}{5}$$

$$x_1 = \frac{400}{13},$$

$$C \rightarrow \left(\frac{400}{13}, \frac{150}{13}\right)$$

Feasible Region is A, B, C, D, E.

$\therefore$

	$Z = 3x_1 + 4x_2$
A (20, 0)	60
B (40, 0)	120
C $\left(\frac{400}{13}, \frac{150}{13}\right)$	138.46.
D (0, 30)	120.
E (0, 25)	100.

As we see, Z is maximum at $C\left(\frac{400}{13}, \frac{150}{13}\right)$

i.e $x_1 = \frac{400}{13}$ and $x_2 = \frac{150}{13}$

or $x_1 = 30.76$, $x_2 = 11.53$

(Ans)

5

$$
\begin{array}{cc|ccc}
 & & \text{I} & \text{II} & \text{III} \\
\hline
 & \text{I} & 2 & 4 & 5 \\
A & \text{II} & 10 & 7 & q \\
 & \text{III} & 4 & p & 6
\end{array}
$$

B.

$$
\begin{array}{cc|ccc}
 & & \text{I} & \text{II} & \text{III} \\
\hline
 & \text{I} & 2 & 4 & 5 \\
A & \text{II} & 10 & 7 & q \\
 & \text{III} & 4 & p & 6
\end{array}
$$

B.

By applying R-maximum principal.

$$
\begin{array}{c|ccc}
 & \text{I} & \text{II} & \text{III} \\
\hline
\text{I} & 2 & 4 & 5 \\
\text{II} & 10 & \boxed{7} & q \\
\text{III} & 4 & p & 6
\end{array}
$$

$q \geq 7$.

By applying Column Maxima →

$$
\begin{array}{c|ccc|c}
 & \text{I} & \text{II} & \text{III} & \\
\hline
\text{I} & 2 & 4 & 5 & 2 \\
\text{II} & \boxed{10} & 7 & q & 7 \\
\text{III} & 4 & p & 6 & 4 \\
\hline
 & 10 & 7 & 6 &
\end{array}
$$

$q \geq 7$.

Column maxima $p \leq 7$

Lets Assum $q = 7$,

If we consider $q = 7$, then q will also be the saddle point. The saddle is already wentten the $(2, 2)$. So, it is not possible

so, $p \leq 7$

$q > 7$.

Group- C

7 b

Destinations.

Factory	D_1	D_2	D_3	D_4	Capacity
F_1	2	3	11	7	6
F_2	1	0	6	1	1
F_3	5	8	15	9	10
Demand	7	5	3	2	

Total Demand = $7+5+3+2 = 17$

Total capacity / supply = $6+1+10 = 17$

As Demand = Capacity it's Balanced

Using voguell's Approximation Method y

Factory	D_1	D_2	D_3	D_4	Capacity	
F_1	2	3	11	7	6	(1)
F_2	1	0	6	$\boxed{1 \; [1]}$	~~1~~ 0	(1)
F_3	5	8	15	9	10	(3)
Demand	7	5	3	~~2~~ 1	17	
	(1)	(3)	(5)	(6)		

	D_1	D_2	D_3	D_4	Capacity	
F_1	2	$\boxed{3 \; [5]}$	11	7	~~6~~ 1	(1)
F_3	5	8	15	9	10	(3)
Demand	7	~~5~~ 0	3	1	11	
	(3)	(5)	(4)	(2)		

7 (b) continuation

	D_1	D_3	D_4	Capacity
F_1	2 [1]	11	7	~~10~~ (5) ←
F_3	5	15	9	10 (4)
Deman	~~7~~ 6	3	1	11
	(3)	(4)	(2)	

	D_1	D_3	D_4	Capacity
F_3	5 [6]	15 [3]	9 [1]	10
	6	3	1	10

Feasible Solution →.

Destination

Factory	D_1	D_2	D_3	D_4	Capacity
F_1	2 [1]	3 [5]	11	7	6
F_2	1	0	6	1 [1]	1
F_3	5 [6]	8	15 [3]	9 [1]	10
Demand	7	5	3	2	17

∴ Total cost → $(2\times1) + (3\times5) + (1\times1) +$
$(5\times6) + (15\times3) + (9\times1)$

$= ₹\ 102$ (Ans)

Group-L

(7) (a) Selling prices of Chip - I = ₹ 1500,
Selling price of Chip - II = ₹ 2500.

Now, ATP,

Let ~~cost of~~ production be x unit of Chip I and y unit of chip II.

For x unit of Chip - I →.
$3x$ hrs skilled Labour + $2x$ hrs of unskilled + $1x$ of raw material.

Again, for y unit of Chip - II →.
$4y$ hrs skilled lbr + $3y$ hrs of unskilled + $2y$ of raw material.

∴ Equating both cases we get →.

$$3x + 4y \leq 120 \quad - (i)$$

120 = Total skilled hr ABM can afford.

then, $2x + 3y \leq 60 \quad - (ii).$

60 → Total Unskilled labor ABM can afford

Again, $x + 2y \leq 30 \quad - (iii).$

30 → Total Raw Material Available.

Now, $Z = 1500x + 2500y$

~~A(0,0)~~
~~B(30,0)~~
~~C(24,3)~~
~~D(~~

The problem is, we have to maximise Z,
when $Z = 1500x + 2500y$ and,

$y \geq 3$

$3x + 4y \leq 120$ — (I)

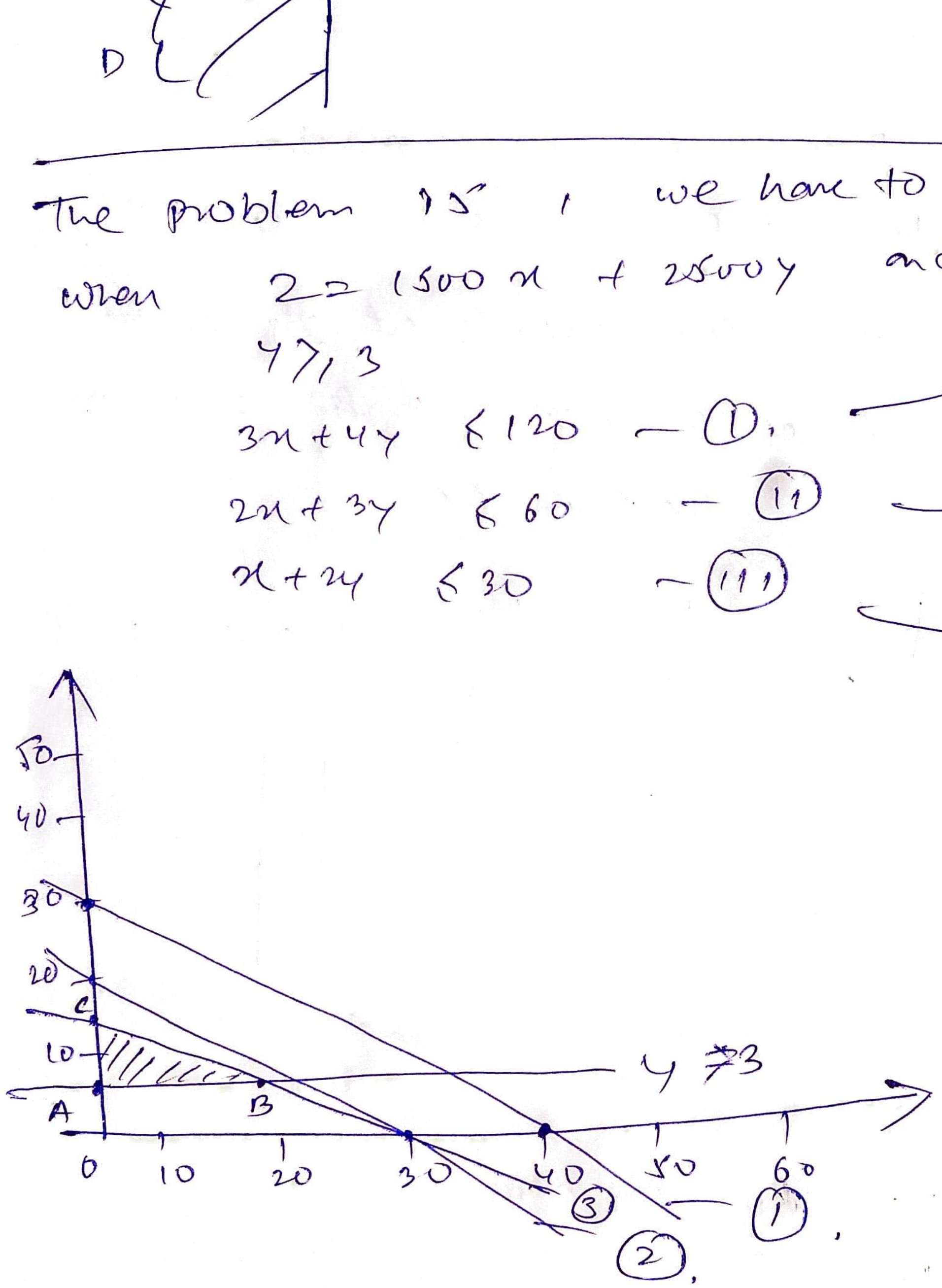
x	40	0
y	0	30

$2x + 3y \leq 60$ — (II)

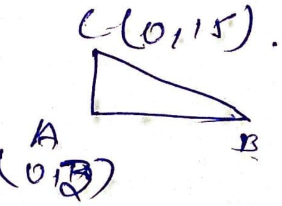
x	30	0
y	0	20

$x + 2y \leq 30$ — (III)

x	30	0
y	0	15



Fesible solution exists in A B C,



For, B → putting $y = 3$ in eqn (3),

$x + 6 = 30$

$x = 24$ B(24, 3)

	$Z = 1500x + 2500y$
A(0, 30)	₹ 7500
B(24, 3)	₹ 43,500
C(0, 15)	₹ 37,500

We see Z i.e profit is maximum at B i.e x is 24 y is 3.

Hence, on producing chip I of 24 units and chip II of 3 unit profit will be maximum (Ans)

Group-C

8 (a)

Jobs	M_1	M_2	M_3	M_4
J_1	1	4	6	3
J_2	9	7	10	9
J_3	4	5	11	7
J_4	8	7	8	5

No. of Jobs = No. of Machines

∴ Balanced.

Now, Applying Row Reductions.

	M_1	M_2	M_3	M_4
J_1	0	3	5	2
J_2	2	0	3	2
J_3	0	1	7	3
J_4	3	2	3	0

Applying column Reduction →

	M1	M2	M3	M4
J1	0	3	2	2
J2	2	0	0	2
→ J3	~~0~~	1	4	3
J4	3	2	0	0

3

→ plus

Again, minimum is 2

	M1	M2	M3	M4
J1	~~0~~	3	2	~~0~~
J2	2	0	0	~~0~~
J3	0	1	4	1
J4	5	4	2	0

Again, Minimum is 1

	M1	M2	M3	M4
J1	0	2	1	0
J2	3	0	0	1
J3	0	0	3	1
J4	5	3	1	0

∴ Allocation

J1 – M1	1
J2 → M3	10
J3 → M2	5
J4 → M4	5

∴ Total loss → 1 + 10 + 5 + 5

= 21 (Ans)

(13)

Grp - C

(8) (b)

$$\begin{array}{c|cccc} & I & II & III & IV \\ \hline I & 5 & -10 & 9 & 0 \\ II & 6 & 7 & 8 & 1 \\ III & 8 & 7 & 15 & 1 \\ IV & 3 & 4 & -1 & 4 \end{array}$$

Dominance rule to reduce the matrix

size →

Playe B.

$$\text{Player A} \begin{bmatrix} 5 & -10 & 9 & 0 \\ 6 & 7 & 8 & 1 \\ 8 & 7 & 15 & 1 \\ 3 & 4 & -1 & 4 \end{bmatrix}$$

$R_2 \leq R_3$ ∴ remove R_2.

plone B.

$$\text{player A} \begin{bmatrix} 5 & -10 & 9 & 0 \\ 8 & 7 & 15 & 1 \\ 3 & 4 & -1 & 4 \end{bmatrix}$$

$R_1 \leq R_2$, remove R_1.

$$\begin{bmatrix} 8 & 7 & 15 & 1 \\ 3 & 4 & -1 & 4 \end{bmatrix} \text{ player A}$$

Player B

$C_2 >, C_4,$ remove C_2.

$$\begin{bmatrix} 8 & 15 & 1 \\ 3 & -1 & 4 \end{bmatrix}$$

Group-C

10 (a)

Job	A	B	C	D	E	
M_1	3	8	5	7	4	27
M_2	4	10	6	5	8	33

Job	M_1	M_2
~~A~~	3	4
B	8	10
~~C~~	5	6
~~D~~	7	5
~~E~~	4	8

A	E	~~B~~ C	B	D

Sequence

Sequence	M_1 In - out	M_2 In - out
A	0 - 3	3 - 7
E	3 - 7	7 - 15
C	7 - 12	15 - 21
B	12 - 20	21 - 31
D	20 - 27	31 - 36.

∴ Total Elapsed Time → 36. hrs. (Ans)

Optimal Sequence is A, E, C, B, D

Ideal time for Machine M_1 = $(36-27)$

= 9 hrs. (Ans)

Ideal time for Machine M_2 = $(36-33)$

= 3 hrs (Ans)

Ideal time for Total System

= $(9+3)$ = 12 hrs (Ans)

Grp-C

10 (b) Given, Demand (D) per day = 100 units.

C_1 = Rs 0.02 — cost per day.

C_3 = Rs 1.00.

$$EOQ = q^0 = \sqrt{\frac{2C_3D}{C_1}} = \sqrt{\frac{2\times 100\times 100}{0.02}}$$

= 1000 units.

Reorder level = Demand per day × Lead Time.

= 100×12 = 1200 units.

∴ Minimum Inventory = Reorder Level − Consumption during Lead Time.

= $1200-1200 = 0$.

Maximum Inventory = Reorder Level + EOQ − ~~compus~~ Consumption During Lead Time.

= $1200+1000-1200$.

= 1000 units.

C_A^0 = Optimal Inventory cost.

$= \sqrt{2 C_1 C_s D}$

$= \sqrt{2 \times 0.02 \times 100 \times 100} = ₹\ 20.$

t^0 = Optimal ordering Interval.

$= \sqrt{\frac{2\ C_s}{D\ C_1}} = \sqrt{\frac{2 \times 100}{100 \times 0.02}} = 10$ days (Ans)

Ans → After each 10 days an order of 1000 neon bulbs is to be placed..

Group - A

1 (i) (b) $(6!)^3$ sequences,

(ii) (c) equality constraint.

(iii) (a) $\lambda/(4-\lambda)$

(iv) - (b) Its total float is zero,

(v) - (a) $z_j - c_j \geq 0$

(vi) (a) 10 days.

(vii) - (b) Saddle point

(ix) - (a) at most n.

(x) - (b) - M

(xi) - (c) m-n

(xii) (c) $\sqrt{2RC_4C_3}$

(xiii) (b) T. P.