KO-5712

M. A. / M. Sc. (Sem.-III) Examination, December-2024

MATHEMATICS

Paper - MATH 301

Operations Research - I

Time Allowed : **Three Hours**

Maximum Marks : 100

Note : This question paper contains two sections as under:

https://www.pyqjelo.com

Section-A **Max. Marks-20**

This section will have ***10*** *questions, having* ***02*** *questions from each unit with no internal choice. Answer in about* ***20*** *words. All questions will have equal marks. (02×10=20)*

Section-B **Max. Marks-80**

This section will have ***10*** *questions, having* ***02*** *questions from each unit, one question to be attempted from each unit. Words limit approximately* ***400-500*** *words. Questions may have sub divisions. All questions will have equal marks. (16×05=80)*

https://pyqlions.com

SECTION - A

1 (i) Write given LLP in standard from for phase-I of two phase method.

Min $z = 4x_1 + 3x_2$

S.t.

$$3x_1 + 2x_2 \leq 4$$

$$5x_1 + 6x_2 \geq 18$$

and $x_1, x_2 \geq 0$

(ii) Define bounded variable LPP.

(iii) Find the dual of the following LPP.

Min. $z = x_1 + x_2 + x_3$

S.t. $x_1 - 3x_2 + 4x_3 = 5$

$$2x_1 - 2x_2 \leq -3$$

$$2x_2 - x_3 \geq 5$$

and $x_1, x_2, x_3 \geq 0$

(iv) State the fundamental theorem of duality.

(v) Define two person zero sum game.

(vi) Define saddle point in game theory.

(vii) Write mathematical model of IPP.

(viii) Write given LPP in standard form-I of revised simplex method

Max. $z = cx$

S.t. $Ax = b$

and $x_1 \geq 0$

(ix) Define network.

(x) Define critical path.

2×10=20

SECTION - B

UNIT - I

2 (i) Solve the following LPP:

Max. $z = 5x_1 + 3x_2$

S.t. $3x_1 + 5x_2 \leq 15$

$5x_1 + 2x_2 \leq 10$

and $x_1, x_2 \geq 0$.

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(ii) Solve the following LPP by two phase method:

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Min. $z = \frac{15}{2} x_1 - 3x_2$

S.t. $3x_1 - x_2 - x_3 \geq 3$

$x_1 - x_2 + x_3 \geq 2$

and $x_1 , x_2 , x_3 \geq 0$

10

OR

2 (i) Solve:

Min. $z = 2x_1 - 10x_2$

S.t. $x_1 - x_2 \geq 0$

$x_1 - 5x_2 \leq -5$

and $x_1 , x_2 \leq 0$

6

https://pyqlelo.com

(ii) Using the bounded variable technique, solve the following LPP:

Max. $z = x_2 + 3x_3$

S.t. $x_1 + x_2 + x_3 \leq 10$

$x_1 - 2x_3 \geq 10$

$2x_2 - x_3 \leq 10$

and $0 \leq x, \leq 8, 0 \leq x_2 \leq 4x_3 \geq 0$.

10

UNIT - II

3 (i) Apply the principle of duality to solve the LPP:

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Max. $z = x_1 + x_2$

S.t. $2x_1 + x_2 \geq 4$

$x_1 + 7x_2 \geq 7$

and $x_1, x_2 \geq 0$

8

(ii) Use dual simplex method to solve:

Min $z = 3x_1 + x_2$

S.t. $x_1 + x_2 \geq 1$

$2x_1 + 3x_2 \geq 2$

8

OR

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3 Find the optimal solution of the given LLP:

Max. $z = 3x_1 + 5x_2$

S.t. $3x_1 + 2x_2 \leq 18$

$x_1 \leq 4$

$x_2 \leq 6$

and $x_1, x_2 \geq 0$

Discuss the effect on the optimality of the solution when the objective function is changed to $z = 3x_1 + x_2$.

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UNIT - III

4 (i) Solve the following game graphically:

Player B

Player A			y_1	y_2	y_3	y_4
			I	*II*	*III*	*IV*
x_1	*I*		2	2	3	−2
$1-x_1$	*II*		4	3	2	6

8

(ii) Use dominance property to solve the following game whose pay-off matrix is:

$$\begin{bmatrix} 3 & 2 & 4 & 0 \\ 3 & 4 & 2 & 4 \\ 4 & 2 & 4 & 0 \\ 0 & 4 & 0 & 8 \end{bmatrix}$$

8

OR

4 (i) Solve the game whose pay-off matrix is given below:

$$\begin{array}{cc} & B \\ & \begin{matrix} I & II & III \end{matrix} \\ A \begin{matrix} I \\ II \\ III \end{matrix} & \begin{bmatrix} 1 & 2 & 1 \\ 0 & -4 & -1 \\ 1 & 3 & -2 \end{bmatrix} \end{array}$$

6

(ii) Solve the following game by the simplex method of linear programming whose pay-off matrix is given as follows:

$$\begin{array}{cc} & \text{Player } B \\ & \begin{matrix} 1 & 2 & 3 \end{matrix} \\ \text{Player } A \begin{matrix} 1 \\ 2 \\ 3 \end{matrix} & \begin{bmatrix} 3 & -1 & -3 \\ -3 & 3 & -1 \\ -4 & -3 & 3 \end{bmatrix} \end{array}$$

10

UNIT - IV

5 Use revised simplex method to solve the following LPP:

Min $z : x_1 + 2x_2$

S.t. $2x_1 + 5x_2 \geq 6$

$x_1 + x_2 \geq 2$

and $x_1, x_2 \geq 0$

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OR

5 Solve the min IPP by using Gomory's method:

Max. $z = x_1 + x_2$

S.t. $3x_1 + 2x_2 \leq 5$

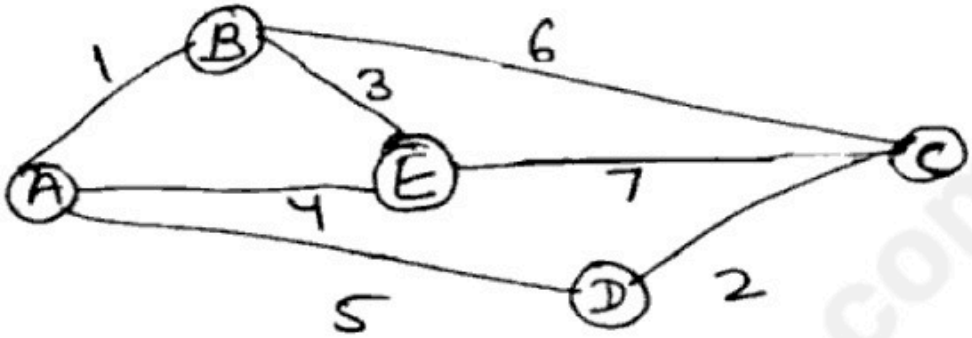
$x_1 \leq 2$

and $x_1, x_2 \geq 0$

16

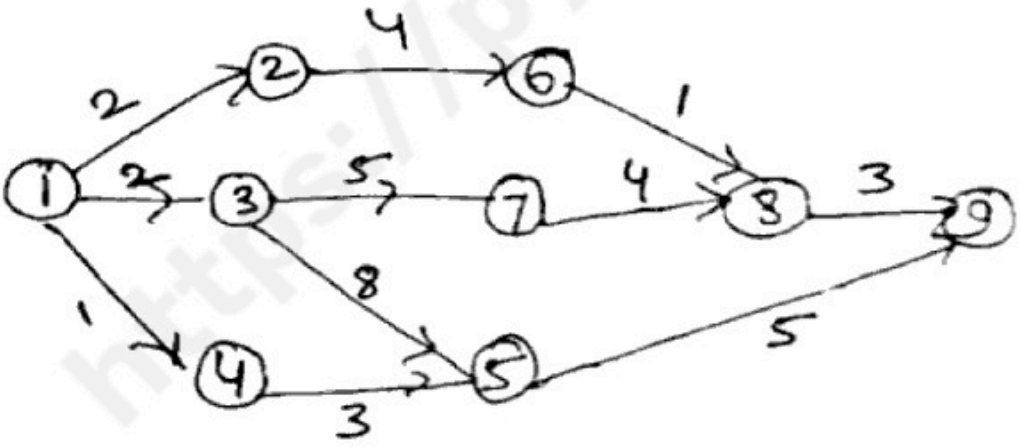
UNIT - V

6 (i) Use Dijkstra's algorithm to determine a shortest path from A to C from the following network:



8

(ii) Find the critical path and calculate the slack time for each event for the following network:



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OR

6 A project has a following time estimates:

Activity (i, j)	Estimated durations (days) Optimistic (t_o)	Most likely (t_m)	Pessimistic (t_p)
(1, 2)	1	1	7
(1, 3)	1	4	7
(1, 4)	2	2	8
(2, 5)	1	1	1
(3, 5)	2	5	14
(4, 6)	2	5	8
(5, 6)	3	6	15

(i) Draw the project network.

(ii) Find the expected duration and variance of each activity.

(iii) Find the early and late occurrence time for each event and the expected project length.

(iv) Calculate the variance and standard deviations of project length.

(v) What is the probability that the project will be completed 4 days earlier than expected.

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