Enrollment No: ______________________ **Exam Seat No:**______________________

C.U.SHAH UNIVERSITY

SummerExamination-2020

Subject Name: Operations Research

Subject Code: 5SC01OPR1 **Branch: M.Sc. (Mathematics)**

Semester : 1 **Date : 04/03/2020** **Time : 02:30 To 05:30** **Marks : 70**

Instructions:

(1) Use of Programmable calculator and any other electronic instrument is prohibited.
(2) Instructions written on main answer book are strictly to be obeyed.
(3) Draw neat diagrams and figures (if necessary) at right places.
(4) Assume suitable data if needed.

SECTION – I

Q-1 **Attempt the Following questions** **(07)**

a. Define: Optimal solution (02)

b. Write canonical form of LP problem. (02)

c. True/False: Every LP problem can be solved graphically. (01)

d. If second variable of the primal is of '=' sign then what will be the sign of second constrain in its dual? (01)

e. True/False: A linear function is always concave function (01)

Q-2 **Attempt all questions** **(14)**

a. Solve by using simplex method (06)

Minimize $Z = x_1 - 3x_2 + 2x_3$
Subject to
$3x_1 - x_2 + 2x_3 \leq 7$
$-2x_1 + 4x_2 \leq 12$
$-4\, x_1 + 3x_2 + 8x_3 \leq 10$
and $x_1, x_2, x_3 \geq 0$

b. Solve by using Graphical method (04)

Minimize $Z = 2x_1 + x_2$
Subject to
$x_1 + x_2 \geq 1$
$x_1 + 2x_2 \leq 10$
$x_2 \leq 4$
and $x_1, x_2 \geq 0$

c. A firm can manufacture three types of cloth namely A,B and C. Three types of wool are required for it – red, green and blue. One unit length of (04) type A cloth needs 2 yards of red wool and 3 yards of blue wool. One unit length of type B cloth needs 3 yards of red, 2 yards of green and 4 yards of blue wool while one unit length of type C needs 5 yards of green wool and 4 yards of blue wool. The firm has a stock of 8 yards of red wool, 10 yards of green wool and 15 yards of blue wool. The income obtained by the firm from one unit length of cloth of type A is Rs. 3 of the type B is Rs. 5 and that of the type C is Rs.4. How should the firm allocate the available material so as to maximize total income from the finished cloth? Formulate the linear programming problem.

OR

Q-2 **Attempt all questions** **(14)**

a. Show that there is an unbounded solution to the following LP problem. (06)

Maximize $Z = 4x_1 + x_2 + 3x_3 + 5x_4$

Subject to

$$4x_1 - 6x_2 - 5x_3 - 4x_4 \geq -20$$
$$-3x_1 - 2x_2 + 4x_3 + x_4 \leq 10$$
$$-8x_1 - 3x_2 + 3x_3 + 2x_4 \leq 20$$

and $x_1, x_2, x_3, x_4 \geq 0$

b. How can formulate a given problem into linear programming problem? (04)

c. Obtain the dual of the following primal LP problem (04)

Maximize $Z = x_1 - 2x_2 + 3x_3$

Subject to constraints

$$-2x_1 + x_2 + 3x_3 = 2$$
$$2x_1 + 3x_2 + 4x_3 = 1$$

and $x_1, x_2, x_3 \geq 0$

Q-3 **Attempt all questions** **(14)**

a. Use two phase method to solve linear programming problem (07)

Minimize $z = x_1 + x_2$

Subject to the constrains

$2x_1 + x_2 \geq 4$

$x_1 + 7x_2 \geq 7$

and $x_1, x_2 \geq 0$

b. Using Big M method to solve the following LP problem (07)

Minimize $z = 5x_1 + 3x_2$

Subject to the constraints

$$2x_1 + 4x_2 \leq 12$$
$$2x_1 + 2x_2 = 10$$
$$5x_1 + 2x_2 \geq 10$$

and $x_1, x_2 \geq 0$.

OR

Q-3 **Attempt all questions** **(14)**

a. Explain North-West corner method. Find the initial basic feasible solution of the following transportation problem by using North-West corner method. (07)

	D_1	D_2	D_3	D_4	D_5	D_6	Supply
S_1	9	12	9	8	4	3	5
S_2	7	3	6	8	9	4	8
S_3	4	5	6	8	10	14	6
S_4	7	3	5	7	10	9	7
S_5	2	3	8	10	2	4	3
Demand	3	4	5	7	6	4	

b. Obtain the initial basic feasible solution by Vogel's approximation method and optimal solution by MODI method. (07)

Destinations

Source		1	2	3	4	a_i
	1	21	16	25	13	**11**
	2	17	18	14	23	**13**
	3	32	27	18	41	**19**
	b_j	**6**	**10**	**12**	**15**	

SECTION – II

Q-4 **Attempt the Following questions** **(07)**

a. Define: Convex function (02)

b. Write mathematical model of assignment model. (02)

c. True/False: A feasible solution to a transportation problem is always a basic feasible solution. (01)

d. True/False: Assignment problem is special case of transportation problem. (01)

e. True/False: Hessian matrix in the case of the function of two variables is $f_{xx} \cdot f_{yy} - (f_{xy})^2$. (01)

Q-5 **(14)**

a. A computer centre has three expert programmers. The centre wants three application programmes to be developed. The head of the computer centre, after carefully studing the programmes to be developed, estimates the computer time in minutes required by the experts for the application programmes as follows: (07)

		Programmers		
		A	B	C
Programmes	1	120	100	80
	2	80	90	110
	3	110	140	120

Assign the programmers to the programmes in such a way that the total computer time is minimum.

b. Use the dual simplex method to solve the following LP problem (07)

Minimize $z = -2x_1 - x_3$

Subject to constraints

$x_1 + x_2 - x_3 \geq 5$

$x_1 - 2x_2 + 4x_3 \geq 8$

and $x_1, x_2, x_3 \geq 0$

OR

Q-5 Attempt all questions (14)

a. Use dual simplex method to solve the LP problem (07)

Minimize $z = -3x_1 - 2x_2$

Subject to constraints

$$x_1 + x_2 \geq 1$$
$$x_1 + x_2 \leq 7$$
$$x_1 + 2x_2 \geq 10$$
$$x_2 \leq 3$$

and $x_1, x_2 \geq 0$

b. There are five workers and their work time to complete their jobs on different machines is given in following table (07)

		Machines				
		M_1	M_2	M_3	M_4	M_5
Workers	W_1	8	5	7	7	8
	W_2	9	5	6	7	8
	W_3	6	8	5	6	9
	W_4	8	10	7	6	5
	W_5	4	6	5	6	4

Assign one machine to each worker that minimizes the total working time.

Q-6 Attempt all questions (14)

a. Find the minimum value of the function $f(x, y, z) = x^2 + y^2 + z^2$ subject to the condition $x + y + z = p$ where p is any real value. (07)

b. Using Hession matrix determine the maximum or minimum point of the function $f(x) = x_1 + 2x_2 + x_1x_2 - x_1^2 - x_2^2$ (07)

OR

Q-6 Attempt all Questions (14)

a. Find extreme value of the function $f(x, y) = x^3 + 3x^2 - y^2$. (07)

b. Determine x_1 and x_2 so as to (07)

Maximize $z = 12x_1 + 21x_2 + 2x_1x_2 - 2x_1^2 - 2x_2^2$

Subject to constraints

$x_2 \leq 8$

$x_1 + x_2 \leq 10$

and $x_1, x_2 \geq 0$.