

(FOR THE CANDIDATES ADMITTED  
DURING THE ACADEMIC YEAR 2020 ONLY)

20UMS408 / 20UMA408

REG.NO. :

N.G.M.COLLEGE (AUTONOMOUS) : POLLACHI

END-OF-SEMESTER EXAMINATIONS : JULY- 2022

B.Sc.-MATHEMATICS

MAXIMUM MARKS: 70

SEMESTER: IV

TIME : 3 HOURS

**PART - III**

**OPERATIONS RESEARCH – I**

**SECTION - A (10 X 1 = 10 MARKS)**

**ANSWER THE FOLLOWING QUESTIONS.**

**MULTIPLE CHOICE QUESTIONS.**

**(K1)**

1. The non negative variables added to the left hand side of all the constraints of " $\leq$ " type are called \_\_\_\_\_ .  
(a) slack variables (b) surplus variables  
(c) artificial variables (d) decision variables
2. In the simplex procedure the objective function of the given LPP is to be \_\_\_\_\_ .  
a. minimized b. maximized c. optimized d. all of these
3. Corresponding to the standard primal problem the dual variables are \_\_\_\_\_ in sign.  
a. non positive b. nonnegative c. restricted d. unrestricted
4. The number of basic variables in an  $m \times n$  balanced transportation problem is \_\_\_\_\_.  
a.  $m + n + 1$  b.  $m + n$  c.  $mn$  d.  $m + n - 1$
5. The equipment should be replaced when the maintenance cost equals the average \_\_\_\_\_ in the replacement policy of deteriorating equipment when the money value does not change with time.  
a) annual total cost b) average cost  
c) Total maintenance cost d) None

**ANSWER THE FOLLOWING IN ONE (OR) TWO SENTENCES.**

**(K2)**

6. Define decision variables.
7. Define feasible solution to an LPP.
8. State the fundamental theorem of duality.
9. What do you mean by balanced Transportation problem?
10. "An assignment problem is a special case of a transportation problem" – Explain.

**SECTION – B**

**(5 X 4 = 20 MARKS)**

**ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS. (K3)**

- 11.a) A factory involved in manufacturing of pistons, rings and valves for which the profits per units are Rs.10, 6 and 4 respectively wants to decide the most profitable mix. It takes one hour of preparatory work, ten hours of machining and two hours of packing for a piston. Corresponding time requirements for the rings and valves are 1, 4 and 2 and 1, 5 and 6 hours respectively. The total number of hours available for preparatory work, machining and packing are 100, 600 and 300 respectively. Formulate the LPP. **(CONTD.....2)**

(OR)

- b) Using graphical method solve the following LPP.

Maximize  $z = 5x_1 + 3x_2$

Subject to the constraints:

$x_1 + x_2 \leq 6$

$2x_1 + 3x_2 \geq 3$

$0 \leq x_1 \leq 3, \quad 0 \leq x_2 \leq 3.$

- 12.a) Find the initial basic feasible solution to the following LPP:

Maximize  $z = 2x_1 - 3x_2$

Subject to the constraints:

$2x_1 + 4x_2 \geq 40$

$3x_1 + 2x_2 \geq 50$

$x_1 \geq 0, x_2 \geq 0$

(OR)

- b) Find all the basic solutions of the equations:

$2x_1 + 6x_2 + 2x_3 + x_4 = 3$

$6x_1 + 4x_2 + 4x_3 + 6x_4 = 2$

- 13.a) Write the dual of the following LPP

Minimize  $z = 4x_1 + 6x_2 + 18x_3$

Subject to the constraints  $x_1 + 3x_2 \geq 3$ 

$x_2 + 2x_3 \geq 5,$

$x_1 \geq 0, x_2 \geq 0, x_3 \geq 0.$

(OR)

- b) Obtain the dual of the following LPP

Maximize  $z = 2x_1 + 5x_2 + 6x_3$

Subject to

$5x_1 + 6x_2 - x_3 \leq 3;$

$-2x_1 + x_2 + 4x_3 \leq 4;$

$x_1 - 5x_2 + 3x_3 \leq 1;$

$-3x_1 - 3x_2 + 7x_3 \leq 6$

$x_1 \geq 0, x_2 \geq 0, x_3 \geq 0.$

- 14.a) Using North west corner rule, find an initial basic feasible solution to the following transportation problem.

|        | D   | E   | F   | G   | Available |
|--------|-----|-----|-----|-----|-----------|
| A      | 11  | 13  | 17  | 14  | 250       |
| B      | 16  | 18  | 14  | 10  | 300       |
| C      | 21  | 24  | 13  | 10  | 400       |
| Demand | 200 | 225 | 275 | 250 |           |

(OR)

- b) Use Vogels Approximation method to obtain an initial basic feasible solution to the Transportation problem:

|        | D  | E  | F  | G  | Available |
|--------|----|----|----|----|-----------|
| A      | 5  | 3  | 6  | 2  | 19        |
| B      | 4  | 7  | 9  | 1  | 37        |
| C      | 3  | 4  | 7  | 5  | 34        |
| Demand | 16 | 18 | 31 | 25 | 90        |

15.a) Solve the following Assignment problem:

| Task | Men |    |    |    |
|------|-----|----|----|----|
|      | 1   | 2  | 3  | 4  |
| I    | 18  | 26 | 17 | 11 |
| II   | 13  | 28 | 14 | 26 |
| III  | 38  | 19 | 18 | 15 |
| IV   | 19  | 26 | 24 | 10 |

(OR)

- b) The cost of a new machine is Rs.5000. The maintenance cost of nth year is given by  $C_n=500(n-1)$ ;  $n=1,2,\dots$ . Suppose that the discount rate per year is 0.5. After how many years it will be economical to replace the machine by a new one?

**SECTION - C**

**(4 X 10 = 40 MARKS)**

**ANSWER ANY FOUR OUT OF SIX QUESTIONS**

**(16<sup>th</sup> QUESTION IS COMPULSORY AND ANSWER ANY THREE QUESTIONS**

**(FROM Qn. No : 17 to 21)**

**(K4 (Or) K5)**

16. Solve the following LPP by the simplex method

$$\text{Maximize } z = 5x_1 + 3x_2$$

Subject to the constraints

$$\begin{aligned} x_1 + x_2 &\leq 2, \\ 5x_1 + 2x_2 &\leq 10 \\ 3x_1 + 8x_2 &\leq 12 \\ x_1 \geq 0, \quad x_2 &\geq 0. \end{aligned}$$

17. A company has two grades of inspectors 1 and 2 who are to be assigned to a quality inspection work. It is required that at least 1800 pieces are inspected per 8-hour day. Grade 1 inspectors can check pieces at the rate of 25 per hour with an accuracy of 98%. Grade 2 inspectors can check at the rate of 15 pieces per hour with an accuracy of 95%. The wage rate for grade 1 inspector is Rs. 40 per hour while that of grade 2 is Rs. 30 per hour. Each time an error is caused by the inspector the cost to the company is Rs. 20. The company has eight grade 1 and ten grade 2 inspectors. The company wants to determine the optimal assignment of inspectors to minimize total inspection cost. Formulate it as LPP and solve using graphical method.

18. Solve the following LPP by using Big-M method

$$\text{Maximize } z = 6x_1 + 4x_2$$

Subject to the constraints

$$\begin{aligned} 2x_1 + 3x_2 &\leq 30 \\ 3x_1 + 2x_2 &\leq 24 \\ x_1 + x_2 &\geq 3 \text{ and } x_1, x_2 \geq 0 \end{aligned}$$

19. Use duality to solve the following LPP

$$\text{Maximize } z = 2x_1 + x_2$$

Subject to the constraints  $x_1 + 2x_2 \leq 10$

$$x_1 + x_2 \leq 6$$

$$x_1 - x_2 \leq 2$$

$$x_1 - 2x_2 \leq 1$$

$$x_1 \geq 0, \quad x_2 \geq 0$$

**(CONTD....4)**

20. Find the optimal solution to the following transportation problem.

|        | P  | Q  | R  | S  | Supply |
|--------|----|----|----|----|--------|
| A      | 23 | 27 | 16 | 18 | 30     |
| B      | 12 | 17 | 20 | 51 | 40     |
| C      | 22 | 28 | 12 | 32 | 53     |
| Demand | 22 | 35 | 25 | 41 |        |

21. A firm is considering replacement of a machine, whose cost price is Rs.12,200 and the scrap value, Rs.200. The running cost in rupees are found from experience to be as follows:

|              |     |     |     |      |      |      |      |      |
|--------------|-----|-----|-----|------|------|------|------|------|
| Year         | 1   | 2   | 3   | 4    | 5    | 6    | 7    | 8    |
| Running cost | 200 | 500 | 800 | 1200 | 1800 | 2500 | 3200 | 4000 |

When should the machine be replaced?

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