

PSG COLLEGE OF ARTS & SCIENCE  
(AUTONOMOUS)

BSc DEGREE EXAMINATION DECEMBER 2024  
(Fifth Semester)

Branch – MATHEMATICS

OPERATIONS RESEARCH – I

Time: Three Hours

Maximum: 50 Marks

SECTION-A (5 Marks)

Answer ALL questions

ALL questions carry EQUAL marks

(5 x 1 = 5)

- 1 The penalty cost of an artificial variable is \_\_\_\_\_.  
(i) 0 (ii) 1 (iii)  $M$  (iv)  $-M$
- 2 In assignment problem involving 4 workers and 3 jobs, total number of assignment possible is \_\_\_\_\_.  
(i) 2 (ii) 3 (iii) 4 (iv) 7
- 3 In an Integer Programming Problem, all the decision variable are \_\_\_\_\_.  
(i) Zero (ii) One  
(iii) Negative integers (iv) Non-negative integers
- 4 The total float of an activity in a critical path is \_\_\_\_\_.  
(i) Zero (ii) One  
(iii) Positive (iv) Negative
- 5 Dynamic Programming is a \_\_\_\_\_ stage decision process.  
(i) single (ii) two (iii) multi (iv) infinite

SECTION - B (15 Marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks

(5 x 3 = 15)

- 6 a Write the computational procedure for determining an optimum solution to a LPP.  
OR  
b Write the steps for formulating a dual problem.
- 7 a Obtain an Initial basic feasible solution for the following TP by Vogel's approximation method:

|        | D   | E  | F   | G  | Supply |
|--------|-----|----|-----|----|--------|
| A      | 40  | 25 | 22  | 33 | 200    |
| B      | 44  | 35 | 30  | 30 | 60     |
| C      | 38  | 38 | 28  | 30 | 140    |
| Demand | 200 | 40 | 120 | 40 |        |

OR

- b Solve the following assignment method:

|   | 1  | 2  | 3  | 4  |
|---|----|----|----|----|
| A | 9  | 26 | 17 | 11 |
| B | 13 | 28 | 4  | 26 |
| C | 38 | 19 | 18 | 15 |
| D | 19 | 26 | 24 | 10 |

- 8 a From the following data:

|     | A | B | C |
|-----|---|---|---|
| I   | 5 | 7 | 3 |
| II  | 4 | 5 | 8 |
| III | 6 | 6 | 9 |

Find the minimum total cost of assigning each worker at the most one job. Formulate this as an integer programming problem.

OR

Cont....

- b Write down the steps involved in solving the Integer Programming by Branch and bound method.
- 9 a Write the rules for constructing a network.

OR

- b Draw a network diagram for the following data:

| Activity           | A | B | C | D | E | F | G     |
|--------------------|---|---|---|---|---|---|-------|
| Preceding Activity | - | - | B | B | B | E | A,D,C |

- 10 a Explain the characteristics of Dynamic Programming.

OR

- b A vessel is to be loaded with stocks of 3 items. Each unit of item  $n$  has a weight  $w_n$  and the value  $v_n$ . The maximum cargo weight, the vessel can take is 5 and the details of the three items are as follows:

| Item ( $n$ ) | Weight ( $w_n$ ) in tons | Value ( $v_n$ ) |
|--------------|--------------------------|-----------------|
| 1            | 1                        | 30              |
| 2            | 3                        | 80              |
| 3            | 2                        | 65              |

Develop the recursive equation for the above case.

**SECTION - C (30 Marks)**

Answer ALL questions

ALL questions carry EQUAL Marks (5 x 6 = 30)

- 11 a Use Simplex method to solve the LPP.

Maximize  $Z = 107x_1 + x_2 + 2x_3$  Subject to the constraints:

$$14x_1 + x_2 - 6x_3 + 3x_4 = 7; 16x_1 + x_2 - 6x_3 \leq 5;$$

$$3x_1 - x_2 - x_3 \leq 0, x_1, x_2, x_3, x_4 \geq 0.$$

OR

- b Use penalty method to solve the LPP

Maximize  $Z = 6x_1 + 4x_2$  Subject to the constraints:

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

- 12 a Find an Optimum solution to the following transportation problem:

|        | 1  | 2  | 3  | 4  | Availability |
|--------|----|----|----|----|--------------|
| 1      | 21 | 16 | 25 | 13 | 11           |
| 2      | 17 | 18 | 14 | 23 | 13           |
| 3      | 32 | 27 | 18 | 41 | 19           |
| Source | 6  | 10 | 12 | 15 | 43           |

OR

- b Solve the following assignment problem:

|   | E  | F  | G  | H  |
|---|----|----|----|----|
| A | 18 | 26 | 17 | 11 |
| B | 13 | 28 | 14 | 26 |
| C | 38 | 19 | 18 | 15 |
| D | 19 | 26 | 24 | 10 |

Cont....

- 13 a Use Branch and bound method to solve the following IPP:

Maximize  $Z = 6x_1 + 8x_2$  Subject to the constraints:

$$4x_1 + 16x_2 \leq 32; 14x_1 + 4x_2 \leq 28; x_1, x_2 \geq 0 \text{ and are integers.}$$

OR

- b Use Branch and bound method to solve the following IPP:

Maximize  $Z = 7x_1 + 9x_2$  Subject to the constraints:

$$-x_1 + 3x_2 \leq 6; 7x_1 + x_2 \leq 35; x_2 \leq 7; x_1, x_2 \geq 0 \text{ and are integers.}$$

- 14 a Three time estimates of all activities of a project are given below:

| Job         | 1 - 2 | 1 - 6 | 2 - 3 | 2 - 4 | 3 - 5 | 4 - 5 | 6 - 7 | 5 - 8 | 7 - 8 |
|-------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Optimistic  | 3     | 2     | 6     | 2     | 5     | 3     | 3     | 1     | 4     |
| Most likely | 6     | 5     | 12    | 5     | 11    | 6     | 9     | 4     | 10    |
| Pessimistic | 15    | 14    | 30    | 8     | 17    | 15    | 27    | 7     | 28    |

Draw the network project and calculate the length and variance of the critical path.

OR

- b Given the following information:

| Activity | 0-1 | 1-2 | 1-3 | 2-4 | 2-5 | 3-4 | 3-6 | 4-7 | 5-7 | 6-7 |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Duration | 2   | 8   | 10  | 6   | 3   | 3   | 7   | 5   | 2   | 8   |

- Draw the network diagram.
  - Identify the critical path and find the total project duration.
  - Determine total, free and independent float.
- 15 a Solve an Optimum Sub-division problem is that divide a positive quantity  $c$  into  $n$  parts in such a way that their product is a maximum.

OR

- b Use Dynamic Programming to solve the following problem

Maximize  $Z = y_1^2 + y_2^2 + y_3^2$  Subject to the constraints:

$$y_1 + y_2 + y_3 \geq 15; y_1, y_2, y_3 \geq 0.$$

Z-Z-Z

END