**(FOR THE CANDIDATES ADMITTED**      SUBJECT CODE   23 PCO 206

**DURING THE ACADEMIC YEAR 2023 ONLY)**      REG.NO. _____

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

## END-OF-SEMESTER EXAMINATIONS : MAY – 2024

**M.Com**                                      **MAXIMUM MARKS: 75**

**SEMESTER : II**                              **TIME : 3 HOURS**

## OPERATIONS RESEARCH
### SECTION – A (10 X 1 = 10 MARKS)

**ANSWER THE FOLLOWING QUESTIONS.**
**MULTIPLE CHOICE QUESTIONS.**                                      **(K1)**

1.    In degenerate solution value of objective function is _____

   (a) One or more basic variables are zero        (b) basic variables are nonzero
   (c) decreases infinitely                        (d) increases infinitely

2.    The solution to a transportation problem with 'm' rows (supplies) & 'n' columns (destination) is basic feasible if number of positive allocations are _____

   (a) m + n            (b) m * n            (c) m + n - 1            (d) m + n + 1

3.    Zero sum game has to be a _____ game.

   (a) single player        (b) two player        (c) multi player        (d) three player

4.    PERT analysis is based on _____

   (a) Optimistic time        (b) Pessimistic time        (c) most likely time        (d) All the above

5.    As simulation is not an analytical model, the result of simulation must be viewed as _____

   (a) unrealistic        (b) approximation        (c) Exact        (d) simplified

## ANSWER THE FOLLOWING IN ONE (OR) TWO SENTENCES.        (K2)

6.    Write down the standard form of a Linear Programming problem.

7.    Define unbalanced transportation problem.

8.    Explain saddle point.

9.    What is dummy activity?

10.    Give the types of simulation.

### SECTION – B          (5 X 5 = 25 MARKS)
## ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.  (K3)

11.   a)   A company manufactures two products A and B.  These products are processed in the same machine.  It takes 10 minutes to process one unit of product A and 2 minutes for each unit of product B and the machine operates for a maximum of 35 hours in a week.  Product A requires 1kg and B requires 0.5 kg of raw material per unit, the supply of which is 600 kg per week.  Market constraint on product B is known to be minimum of 800 units every week.  Product A costs Rs.5 per unit and sold at Rs.10, Product B costs Rs.6 per unit and can be sold in the market at a unit price of Rs.8.  Determine the number of units of A and B per week to maximize the profit.

**(CONTD …. 2)**

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**(OR)**

b) Use simplex method to solve the LPP: Max $Z = 3x_1 + 2x_2$ subject to,

$$x_1 + x_2 \leq 4,$$
$$x_1 - x_2 \leq 2,$$
$$x_1, x_2 \geq 0$$

12. a) Determine an initial basic feasible solution to the following transportation problem using Vogel's Approximation method.

| | 1 | 2 | 3 | 4 | Supply |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 11 | 7 | 6 |
| 2 | 1 | 0 | 6 | 1 | 1 |
| 3 | 5 | 8 | 15 | 9 | 10 |
| Required | 7 | 5 | 3 | 2 | 17 |

**(OR)**

b) A company has one surplus truck in each of the cities A, B, C, D and E and one deficit truck in each of the cities 1, 2, 3, 4, 5 and 6. The distance between the cities in kilometers is shown in the matrix below. Find the assignment of trucks from cities in surplus to cities in deficit so that the total distance covered by the vehicles is minimum.

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| A | 12 | 10 | 15 | 22 | 18 | 8 |
| B | 10 | 18 | 25 | 15 | 16 | 12 |
| C | 11 | 10 | 3 | 8 | 5 | 9 |
| D | 6 | 14 | 10 | 13 | 13 | 12 |
| E | 8 | 12 | 11 | 7 | 13 | 10 |

13. a) Find the solution of game theory problem using saddle point.

| Player A\Player B | $B_1$ | $B_2$ | $B_3$ | $B_4$ |
|---|---|---|---|---|
| $A_1$ | 20 | 15 | 12 | 35 |
| $A_2$ | 25 | 14 | 8 | 10 |
| $A_3$ | 40 | 2 | 10 | 5 |
| $A_4$ | -5 | 4 | 11 | 0 |

**(OR)**

b) Find the ranges of values of $p$ and $q$ which will render the entry (2,2) a saddle point for the game.

| | Player B | | |
|---|---|---|---|
| | 2 | 4 | 5 |
| Player A | 10 | 7 | $q$ |
| | 4 | $p$ | 16 |

**(CONTD …. 3)**

14. a) Determine the optimum project duration and cost for the following data.

| Activity | Normal | | Crash | |
|---|---|---|---|---|
| | Time (days) | Cost (Rs) | Time (days) | Cost (Rs) |
| 1-2 | 8 | 100 | 6 | 200 |
| 1-3 | 4 | 150 | 2 | 350 |
| 2-4 | 2 | 50 | 1 | 90 |
| 2-5 | 10 | 100 | 5 | 400 |
| 3-4 | 5 | 100 | 1 | 200 |
| 4-5 | 3 | 80 | 1 | 100 |

Indirect cost is Rs.70 per day.

**(OR)**

b) Determine the critical path, the critical activities and the project completion time using CPM network method.
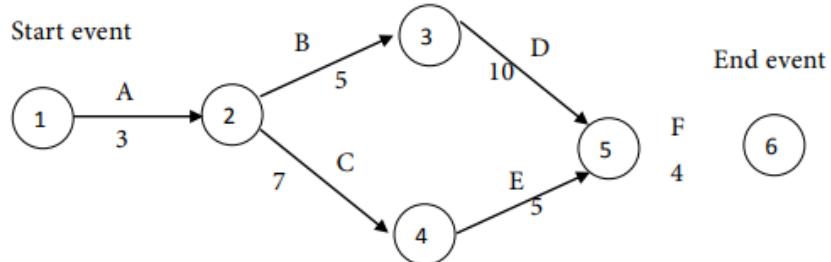


15. a) Briefly explain Monte-Carlo Simulation.

**(OR)**

b) Discuss the advantages and disadvantages of simulation.

## SECTION – C (5 X 8 = 40 MARKS)

**ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.** (K4 (Or) K5)

16. a) Solve the following LPP graphically. Min $Z = 200x + 500y$ subject to,

$$x + 2y \geq 10,$$
$$3x + 4y \leq 24,$$
$$x, y \geq 0.$$

**(OR)**

b) Solve the following LPP using Simplex method. Max $Z = 30x_1 + 20x_2$ subject to,

$$10x_1 + 8x_2 \leq 800,$$
$$x_1 \leq 60, \quad x_2 \leq 75, \quad x_1, x_2 \geq 0$$

**(CONTD …. 4)**

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17. a) Solve the following Transportation problem

|  |  | Destination | | | | |
|---|---|---|---|---|---|---|
|  |  | P | Q | R | S | Supply |
|  | A | 21 | 16 | 25 | 13 | 11 |
| Source | B | 17 | 18 | 14 | 23 | 13 |
|  | C | 32 | 17 | 18 | 41 | 19 |
|  | Demand | 6 | 10 | 12 | 15 | 43 |

**(OR)**

b) A machine operator processes 5 types of items on his machine each week, and must choose a sequence for them. The set-up cost per change depends on the item presently on the machine and the set-up to be made according to the following table.

|  | A | B | C | D | E |
|---|---|---|---|---|---|
| A | $\alpha$ | 4 | 7 | 3 | 4 |
| B | 4 | $\alpha$ | 6 | 3 | 4 |
| C | 7 | 6 | $\alpha$ | 7 | 5 |
| D | 3 | 3 | 7 | $\alpha$ | 7 |
| E | 4 | 4 | 5 | 7 | $\alpha$ |

If he processes each type of item once and only once each week, how should he sequence the items on his machine in order to minimize the total set-up cost?

18. a) Reduce the following game by Dominance and find the game value.

|  | I | II | III | IV | V |
|---|---|---|---|---|---|
| I | 1 | 3 | 2 | 7 | 4 |
| II | 3 | 4 | 1 | 5 | 6 |
| III | 6 | 5 | 7 | 6 | 5 |
| IV | 2 | 0 | 6 | 3 | 1 |

**(OR)**

b) Reduce the following game by Dominance and find the game value.

|  | I | II | III | IV |
|---|---|---|---|---|
| I | 3 | 2 | 4 | 0 |
| II | 3 | 4 | 2 | 4 |
| III | 4 | 2 | 4 | 0 |
| IV | 0 | 4 | 0 | 8 |

**(CONTD …. 5)**

19.  a)   A small project consisting of eight activities has the following characteristics:

### Time – Estimates (in weeks)

| Activity | Preceding activity | Most optimistic time (a) | Most likely time (m) | Most Pessimestic time (b) |
|----------|-------------------|--------------------------|----------------------|---------------------------|
| A | None | 2 | 4 | 12 |
| B | None | 10 | 12 | 26 |
| C | A | 8 | 9 | 10 |
| D | A | 10 | 15 | 20 |
| E | A | 7 | 7.5 | 11 |
| F | B,C | 9 | 9 | 9 |
| G | D | 3 | 3.5 | 7 |
| H | E, F, G | 5 | 5 | 5 |

(i)   Draw the PERT network for the project.

(ii)  Prepare the activity schedule for the project.

(iii) Determine the critical path.

(iv)  If a 30- week deadline is imposed, what is the probability that the project will be finished within the time limit?

**(OR)**

b)   Draw the network diagram and determine the critical path for the following project:

| Activity | 1-2 | 1-3 | 1-4 | 2-5 | 3-6 | 3-7 | 4-7 | 5-8 | 6-8 | 7-9 | 8-9 |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Time estimate (Weeks) | 5 | 6 | 3 | 5 | 7 | 10 | 4 | 2 | 5 | 6 | 4 |

20.  a)   A machine costs Rs.6,000.  The running costs and the salvage value at the end of the year are given below.

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|------|-----|-----|-----|-----|-----|-----|-----|
| Running cost | 1200 | 1400 | 1600 | 1800 | 2000 | 2400 | 3000 |
| Salvage value | 4000 | 2666 | 2000 | 1500 | 1000 | 600 | 600 |

If the interest rate is 10% per year, when should the machine be replaced?

**(OR)**

b)   A machine costs Rs.15,000.  The running costs for the different years are given below.

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|------|------|------|------|------|------|------|-------|
| Running | 2500 | 3000 | 4000 | 5000 | 6500 | 8000 | 10000 |

Calculate the optimum replacement period if the capital is worth 10% per annum and has no salvage value.

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