

**JK Lakshmipat University Jaipur**  
**INSTITUTE OF ENGINEERING AND TECHNOLOGY**

End Term Examination (Backlog), November-December 2015  
B. Tech. / B. Tech. + MBA (Common for all Branches), Semester VI

Roll No.....

**MA 601: OPTIMIZATION TECHNIQUES**

**Time: 3 hours**

**Max. Marks: 100**

**Instructions to students:**

1. Do not write anything other than your roll number on question paper.
2. Draw the graphs neatly and legible. Write your roll number and question number on the graph paper.

**Q.1 Choose the correct answer for the following problems (10 questions @ 1 mark) 10**

- i. In applying Vogel's approximation method to a profit maximization problem, row and column penalties are determined by
  - (a) finding the largest unit cost in each row or column
  - (b) finding the smallest unit cost in each row or column
  - (c) finding the difference between the two lowest unit costs in each row and column
  - (d) finding the sum of the unit costs in each row or column
- ii. Dominance principle in game theory
  - (a) reduces the size of the pay-off matrix
  - (b) reduces the game value
  - (c) Both (a) and (b)
  - (d) None of these
- iii. To start with the simplex iteration, the starting basis matrix B is
  - (a) I
  - (b) -I
  - (c) zero
  - (d) None of these
- iv. Which method usually gives a very good solution to the assignment problem?;
  - (a) MODI
  - (b) Vogel's approximation
  - (c) Hungarian
  - (d) none of these
- v. The minimal-spanning tree technique would best be used;
  - (a) by an architect to lay out corridors between offices in a new office building
  - (b) by a telephone company attempting to lay out wires in a new housing development
  - (c) by an airline laying out flight routes
  - (d) none of these
- vi. Which of the following is usually the most difficult cost to determine?
  - (a) service cost
  - (b) facility cost
  - (c) calling cost
  - (d) waiting cost
- vii. Which of the following are advantages of simulation?
  - (a) Simulation allows "what-if?" type of questions
  - (b) Simulation can usually be performed by hand or using a small calculator
  - (c) Simulation does not interfere with the real-world system
  - (d) (a) and (c) only
- viii. Which of the following constraints is not linear?
  - (a)  $7A - 6B \leq 45$
  - (b)  $X + Y + 3Z = 35$
  - (c)  $2X + 10Y \geq 60$
  - (d)  $2XY + X \geq 15$
- ix. Which of the following is not a requirement for a goal programming problem?
  - (a) prioritization of goals
  - (b) a single objective function
  - (c) linear constraints
  - (d) linear objective function
- x. In a mixed strategy, each player should optimize the
  - (a) maximum payoffs
  - (b) lower value of the game
  - (c) minimum loss
  - (d) maximum loss

**Q.2 Solve the following problems (4 questions @ 2.5 marks)**

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i. Write down the dual of the following primal LP problem:

$$\text{Minimize } Z = x_1 - 2x_2 + x_3$$

$$\text{Subject to: } x_1 - 2x_2 + x_3 = 6; x_1 + 12x_2 + 2x_3 = 14 \text{ and } x_1, x_2, x_3 \geq 0$$

ii. Define optimization then explain the engineering applications of optimization.

iii. Explain simulation v/s mathematical modeling with the help of cases.

iv. Explain (a) Integer Programming Problem and (b) Non-linear Programming Problem

**Q.3A Use the graphical method to solve the following LP problem.**

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$$\text{Maximize } Z = 2x_1 + 3x_2$$

$$\text{Subject to: } 6x_1 + 5x_2 \leq 25; x_1 + 3x_2 \leq 10 \text{ and } x_1, x_2 \geq 0.$$

**Q.3B Construct a network for the project whose activities and their precedence relationship are given below:**

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| Activity              | A | B | C | D | E   | F    | G | H | I    | J    | K |
|-----------------------|---|---|---|---|-----|------|---|---|------|------|---|
| Immediate Predecessor | - | A | A | C | B,C | D, E | E | G | D, F | I, H | J |

**Q.4A Formulate the given transportation problem in terms of LPP**

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|                | R <sub>1</sub>        | R <sub>2</sub>       | R <sub>3</sub>        | R <sub>4</sub>        | R <sub>5</sub>        | Supply |
|----------------|-----------------------|----------------------|-----------------------|-----------------------|-----------------------|--------|
| S <sub>1</sub> | X <sub>11</sub><br>1  | X <sub>12</sub><br>3 | X <sub>13</sub><br>16 | X <sub>14</sub><br>36 | X <sub>15</sub><br>55 | 150    |
| S <sub>2</sub> | X <sub>21</sub><br>2  | X <sub>22</sub><br>2 | X <sub>23</sub><br>1  | X <sub>24</sub><br>20 | X <sub>25</sub><br>10 | 100    |
| S <sub>3</sub> | X <sub>31</sub><br>11 | X <sub>32</sub><br>5 | X <sub>33</sub><br>11 | X <sub>34</sub><br>13 | X <sub>35</sub><br>6  | 100    |
| Demand         | 80                    | 60                   | 50                    | 50                    | 60                    |        |

**Q.4B Solve the following assignment problem.**

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|   | 1  | 2  | 3  | 4  | 5  |
|---|----|----|----|----|----|
| A | 40 | 35 | 25 | 20 | 15 |
| B | 16 | 26 | 48 | 50 | 24 |
| C | 22 | 12 | 32 | 15 | 17 |
| D | 16 | 18 | 12 | 15 | 36 |
| E | 45 | 20 | 36 | 24 | 18 |

Q.5A Use dynamic programming to solve the following problem. 05

$$\text{Minimize } Z = x_1^2 + x_2^2 + x_3^2$$

Subject to:  $x_1 x_2 x_3 = 27$  and  $x_1, x_2, x_3 \geq 0$

Q.5B Use graphical method to find the optimal strategy of each player and the value of the following game. 05

|          |   | Player B |    |     |    |    |
|----------|---|----------|----|-----|----|----|
|          |   | I        | II | III | IV | V  |
| Player A | 1 | -5       | 5  | 0   | -1 | 8  |
|          | 2 | 8        | -4 | -1  | 6  | -5 |

Q.6A State the Kuhn-Tucker conditions. Write down the Kuhn-Tucker conditions to get an optimal solution of the following Non-linear programming problem: 05

$$\text{Maximize } Z = x + 14y - x^2 - y^2$$

Subject to:  $12x + 3y \leq 15$  and  $x, y \geq 0$ .

Q.6B Describe, briefly, the steps in the shortest-route technique. 05

Q.7A Explain Monte Carlo simulation with the help of real life application. 05

Q.7B Sal's International Barbershop is a popular haircutting and styling salon near the campus of the University of New Orleans. Four barbers work full-time and spend an average of 15 minutes on each customer. Customers arrive all day long at an average rate of 12 per hour. When they enter, they take a number to wait for the first available barber. Arrivals tend to follow the Poisson distribution, and service times are exponentially distributed. 05

(a) What is the probability that the shop is empty?

(b) What is the average number of customers in the barbershop?

(c) What is the average time spent in the shop?

Q.8 A small project is composed of nine activities whose time estimates are listed in the table below: 10

| Activity               | 1-2 | 1-3 | 2-3 | 2-4 | 3-4 | 4-5 |
|------------------------|-----|-----|-----|-----|-----|-----|
| Duration (Optimistic)  | 20  | 9   | 3   | 2   | 1   | 12  |
| Duration (Most likely) | 30  | 12  | 5   | 3   | 2   | 18  |
| Duration (Pessimistic) | 46  | 21  | 7   | 4   | 3   | 24  |

(a) Draw the project network diagram.

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

(c) Find the critical path and expected project length.

(d) Calculate the variance and standard deviation of project length. What is the probability that the project will be completed in 50 days?

Q.9 Solve the following LPP using the dual simplex method. 10

$$\text{Maximize } Z = x_1 - x_2 + x_3$$

Subject to:  $x_1 + x_2 + x_3 \leq 10$ ;  $x_1 - x_2 + 3x_3 \leq 2$ ;  $x_1 + x_2 - x_3 \leq 5$  and  $x_1, x_2, x_3 \geq 0$ .

OR

Q.9 Use simplex method to solve the following LP Problem.

$$\text{Maximize } Z = 4x_1 + 3x_2 + 6x_3$$

Subject to:  $2x_1 + 3x_2 + 2x_3 \leq 440$ ;  $4x_1 + 3x_3 \leq 470$ ;  $2x_1 + 5x_2 \leq 430$  and  $x_1, x_2, x_3 \geq 0$ .

Q.10 Find the optimal solution using Vogel's method followed by MODI method.

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|                | D <sub>1</sub> | D <sub>2</sub> | D <sub>3</sub> | D <sub>4</sub> | Available |
|----------------|----------------|----------------|----------------|----------------|-----------|
| O <sub>1</sub> | 4              | 6              | 8              | 13             | 50        |
| O <sub>2</sub> | 13             | 11             | 10             | 8              | 70        |
| O <sub>3</sub> | 14             | 4              | 10             | 13             | 30        |
| O <sub>4</sub> | 9              | 11             | 13             | 8              | 50        |
| Required       | 25             | 35             | 105            | 20             |           |

OR

Q.10 Apply the revised simplex method to solve the following LP Problem.

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

Subject to:  $3x_1 + 2x_2 + x_3 \leq 3$ ;  $2x_1 + x_2 + 2x_3 \leq 2$  and  $x_1, x_2, x_3 \geq 0$ .