

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), April-May 2018

B. Tech (CHE), Semester VI

Roll No.....

MA621: Engineering Optimization

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Calculators are allowed.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark) 10

- i. If the total supply is not equal to the total demand in a transportation problem, then it is
(a) a degenerate problem (b) a balanced problem
(c) an unbalanced problem (d) a non-degenerate problem
- ii. An assignment problem can be solved using
(a) simplex method (b) transportation model (c) Hungarian method (d) All of these
- iii. A constraint that does not affect the feasible region is a
(a) non-negativity constraint (b) redundant constraint (c) standard constraint (d) slack constraint
- iv. Games which involve more than two players are called
(a) two person zero sum game (b) conflicting game (c) N-person game (d) negotiable game
- v. Dynamic programming approach can be applied to
(a) linear problems (b) non-linear problems (c) linear /non-linear both (d) multi objective problems
- vi. When an additional variable is added to the a LP model, the existing optimal solution can further be improved if
(a) $Z_j - C_j < 0$ (b) $Z_j - C_j \geq 0$ (c) either (a) or (b) (d) both (a) or (b)
- vii. KT conditions are used for
(a) DPP (b) LPP (c) NLPP (d) None of theses
- viii. The goal programming approach attempts to achieve the each objective
(a) simultaneously (b) randomly (c) sequentially (d) None of theses
- ix. The algorithm used to find the minimal spanning tree is
(a) Kruskal's (b) Dijkstra (c) PERT (d) CPM
- x. How many artificial variables will be required to solve the following LPP using Simplex method
Max. $Z = 5X_1 + 7X_2$
s.t. $X_1 + X_2 \geq 4$
 $3X_1 + 8X_2 \leq 24$
 $10X_1 + 7X_2 = 35$
and $X_1 \geq 0, X_2 \geq 0$.

(a) 0 (b) 1 (c) 2 (d) 3

Q.2 Short answer type questions (4 questions @ 2.5 marks)

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Q.2A Write the dual of

$$\text{Min } Z = 3x_1 - x_2 + 8x_3$$

s. to. $5x_1 - x_2 + x_3 \leq 5$; $4x_1 - 2x_2 \geq 17$; $-8x_1 + 4x_2 + 3x_3 = 8$
and $x_1, x_2 \geq 0$, x_3 is unrestricted.

Q.2B Define optimization then explain the engineering applications of optimization.

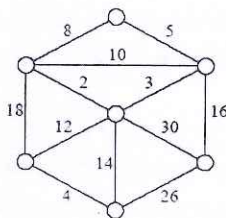
Q.2C Write any two advantages and two limitations of linear programming.

Q.2D Solve the games whose payoff matrices are given by

		Player B		
		B1	B2	B3
Player A	A1	1	3	1
	A2	0	-4	-3
	A3	1	5	-1

Q.3A Give minimal spanning tree for the following graph by Kruskal's algorithm.

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Q.3B Obtain the initial basic feasible solution of the following transportation problem
Least cost method/Vogel's Approximation method

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Source ↓ → Destination	A	B	C	D	Availability
X	2	3	11	7	6
Y	1	5	6	1	4
Z	5	8	15	9	10
Demand	8	6	3	3	

Q.4A A company produces two types of leather belts, A and B. Belt A are of superior quality and B is of an inferior quality. The profit from the two is 40 and 30 paise per belt, respectively. Each belt of type A requires twice as much time as required by a belt of type B. If all the belts were of type B, the company could produce 1000 belts per day. But the supply of the leather is sufficient only for 800 belts per day. Belt A requires a fancy buckle and only 400 of them are available per day. For belt B only 700 buckles are available per day. Formulate the problem to determine how many units of the two types of belts the company should manufacture in order to have the maximum overall profit.

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Q.4B Use dynamic programming technique to solve following LPP

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Max. $Z = 3x_1 + 4x_2$ subject to the constraints
 $2x_1 + 5x_2 \leq 120$, $2x_1 + x_2 \leq 40$ and $x_1, x_2 \geq 0$

- Q.5A A company has 4 salesmen A, B, C and D. These salesmen are to be allotted 4 districts I, II, III and IV. The estimated profit per day for each salesman in each district is given in the following table? 5

	I	II	III	IV
A	16	10	14	11
B	14	1	15	15
C	15	15	13	12
D	16	12	14	15

What is the optimal assignment which will yield maximum profit?

- Q.5B Use dual simplex method to solve the following LPP: 5

$$\begin{aligned} \text{Minimise } Z &= x_1 + 2x_2 \\ \text{s.t. } x_1 + 2x_2 &\leq 7 \\ 2x_1 + x_2 &\geq 4 \\ \text{and } x_1, x_2, x_3 &\geq 0 \end{aligned}$$

- Q.6A Solve the following Integer Programming Problem: 10

$$\text{Min. } Z = 9x_1 + 10x_2$$

$$\begin{aligned} \text{s.t. } x_1 &\leq 9 \\ x_2 &\leq 8 \\ 4x_1 + 3x_2 &\geq 40 \\ x_1, x_2 &\geq 0 \text{ and are integers.} \end{aligned}$$

- Q.7A A company has four plants manufacturing the same product and five sale centers. The cost of manufacturing, cost of raw materials and capacities of the plants are given below: 10

Plants	Manufacturing cost per unit	Raw material cost per unit	Capacity
1	20	8	100
2	10	7	200
3	8	7	120
4	8	5	80

The sales prices, transportation costs and demands are given in the following table

Sales Center	Transportation cost per unit				Unit sales price	Demand
	1	2	3	4		
A	4	7	4	3	30	80
B	8	9	7	8	32	120
C	2	7	6	10	28	150
D	10	7	5	8	34	70
E	2	5	8	9	30	90

Formulate this problem into a transportation problem to maximize profit and find the optimal solution.

OR

- Q.7A Use revised simplex method to solve the following: 10

$$\begin{aligned} \text{Minimise } Z &= -4x_1 + x_2 + 2x_3 \\ \text{s.t. } 2x_1 - 3x_2 + 2x_3 + x_4 &\leq 12 \end{aligned}$$

$$-5x_1 + 2x_2 + 3x_3 \geq 4$$

$$3x_1 - 2x_3 = -1$$

$$\text{and } x_1, x_2, x_3 \geq 0$$

- Q.8A The following is a payoff matrix which describes the strategies open to two players and the payoff player A.

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		Player B			
		B1	B2	B3	B4
Player A	A1	-1	-2	8	3
	A2	7	5	-1	3
	A3	6	0	12	7

- Does a saddle point exist?
- What strategies should players 1 and 2 take?
- What is the value of the game?
- Would it be advantageous for player A to exchange strategies? Explain why?

- Q.9A State the Kuhn-Tucker conditions. Write down the Kuhn-Tucker conditions and find the optimal solution of the following Non-linear programming problem:

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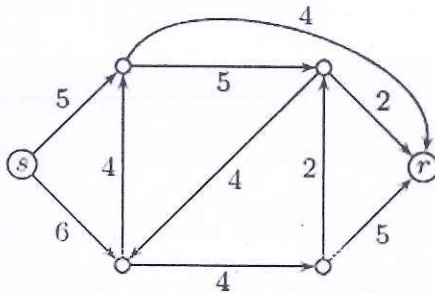
$$\text{Minimize } Z = 2x_1 + 3x_2 - x_1^2 - 2x_2^2$$

Subject to: $x_1 + 3x_2 \leq 6$, $5x_1 + 2x_2 \leq 10$ and $x_1, x_2 \geq 0$

- Q.9B (i) Describe the Dijkstra's algorithm for shortest path.

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- (ii) Determine the shortest-path from s to r of the following digraph by Dijkstra's algorithm



OR

- Q.9B Jain and Co. manufacture two types of products A and B. According to past experience, production of either A or B requires an average of one hour in the plant. The plant has normal production capacity of 400 hours a month. The marketing department of the firm reports that because of limited market, the maximum number of A or B that can be sold in a month are \$ 800 and \$ 400 respectively. The manager of firm has set the following goals arranged in the order of

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- He wants to avoid any underutilization of normal production capacity.
 - He wants to sell maximum possible units of A and B. Since the net profit from the sale of product is twice the amount from that of product B.
 - He wants to minimize the overtime operation of the plant as much as possible.
- Formulate this as a goal programming and solve it.