

Name :

Roll No. :

Invigilator's Signature :

CS/B.Tech(CSE/OLD)/SEM-4/M(CS)-402/2013

2013

**OPERATIONS RESEARCH AND OPTIMIZATION
TECHNIQUE**

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

Graph sheet(s) will be supplied by the institution.

GROUP – A

(Multiple Choice Type Questions)

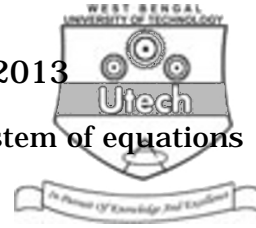
1. Choose the correct alternatives for any *ten* of the following :

10 × 1 = 10

- i) For a maximization problem, the objective function coefficient for an artificial variable is
 - a) + M
 - b) – M
 - c) zero
 - d) none of these.
- ii) If dual has an unbounded solution, primal has
 - a) No feasible solution
 - b) Unbounded solution
 - c) Feasible solution
 - d) None of these.

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iii) The basic feasible solutions of the system of equations

$$x_1 + x_2 + x_3 = 8$$

$$3x_1 + 2x_2 = 18 \text{ are}$$

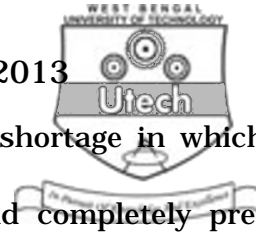
- a) no basic solution
 - b) $(2, 6, 0), (6, 0, 2)$
 - c) $(1, 7, 0), (7, 1, 0)$
 - d) none of these.
- iv) In an assignment problem, the minimum number of lines covering all zeros in the reduced cost matrix of order n can be
- a) at most n
 - b) $n + 1$
 - c) $n - 1$
 - d) at least n .
- v) The number of basic variables in a Transportation problem is at most
- a) $m + n + 1$
 - b) $m + n$
 - c) $m + n - 1$
 - d) $m - n + 1$.



- vi) A two-person game is said to be zero sum if
- gain of one player is exactly matched by a loss of the other so that their sum is equal to zero
 - gain of one player does not match the loss of the other
 - both the players must have equal number of strategies
 - diagonal entries of the pay-off matches are zero.
- vii) The range of values of p and q which will render the entry $(2, 2)$ a saddle point for the game is

	B strategies		
	B_1	B_2	B_3
A_1	2	4	5
A_2	10	7	q
A_3	4	p	6

- $p \leq 7$ and $q \geq 7$
- $p = 7$ and $q = 7$
- $p \geq 7$ and $q \leq 7$
- $p \leq 7$ and $q \leq 7$.



- viii) In EOQ inventory problem with no shortage in which demand is assumed to be fixed and completely pre-determined, the economic lot size is

a) $\sqrt{\frac{2DC_o}{C_h}}$

b) $\sqrt{\frac{2DC_h}{C_o}}$

c) $\sqrt{2DC_o C_h}$

- d) None of these,

where D is the demand rate, C_o is the ordering cost or set-up cost and C_h is the holding cost or carrying cost.

- ix) The total number of possible solutions for $n \times n$ assignment problem is always

a) n

b) $n - 1$

c) 1

d) $n!$



- x) A $n \times n$ assignment problem
- a) is not an LPP and it is a particular case of Transportation Problem
 - b) is an LPP and it is a particular case of Transportation Problem
 - c) requires that only one activity be assigned to each resource
 - d) none of these.
- xi) In a travelling salesman problem, the salesman can visit a city twice, until he has visited all the cities
- a) once
 - b) twice
 - c) thrice
 - d) none of these.
- xii) An activity is said to be critical activity iff
- a) its free float is zero
 - b) its total float is zero
 - c) its independent float is zero
 - d) its time duration is zero.

**GROUP - B****(Short Answer Type Questions)**Answer any *three* of the following. $3 \times 5 = 15$

2. Solve graphically the following LPP :

Maximize $z = 5x_1 - 2x_2$

Subject to the constraints

$5x_1 + 6x_2 \geq 30$

$9x_1 - 2x_2 = 72$

$x_2 \leq 9$

$x_1, x_2 \geq 0$

3. For what value of
- λ
- , the game with the following payoff matrix is strictly determinable ?

	B ₁	B ₂	B ₃
A ₂	λ	7	3
A ₃	-2	λ	-8
	-3	4	λ

4. Find the dual of the following LPP :

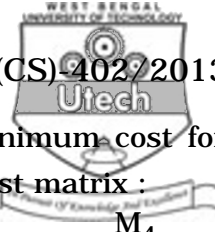
Minimize $Z = 2x_2 + 6x_3$

subject to

$9x_1 + 3x_2 \geq 20$

$2x_1 + 7x_2 = 40$

$x_1, x_2 \geq 0$



5. Find the optimal assignments to find the minimum cost for the assignment problem with the following cost matrix :

	M_1	M_2	M_3	M_4
J_1	18	24	28	32
J_2	8	13	17	18
J_3	10	15	19	22

GROUP - C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

6. a) Use simplex algorithm to solve the following LPP : 5

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

subject to

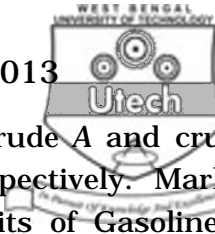
$$2x_1 + x_2 \leq 2$$

$$3x_1 + 4x_2 \geq 12$$

where $x_1, x_2 \geq 0$

- b) The manager of an oil company must decide on the optimum mix of two possible blending processes of which the input and output production runs are as follows :

Process	Input		Output	
	Grade A	Grade B	Gasoline X	Gasoline Y
1	6	4	6	9
2	5	6	5	5



The maximum amount available for crude A and crude B are 250 units and 200 units respectively. Market demand shows that at least 150 units of Gasoline X and 130 units of Gasoline Y must be produced. The profits per production run from process 1 and process 2 are Rs. 4 and Rs. 5 respectively.

- i) Formulate the problem as an L.P.P. for maximizing the total profit.
 - ii) Use the graphical method to solve this problem. 10
7. a) Determine the optimal basic feasible solution of the following Transportation Problem by Vogel's Approximation Method :

		Destinations			
		I	II	III	a_i
Sources	1	4	3	2	10
	2	1	5	0	13
	3	3	8	6	12
	b_j	8	5	4	

10

- b) Three persons are being considered for three open positions. Each person has been given a rating for each position as shown in the following table :

		Position		
		I	II	III
Person	1	7	5	6
	2	8	4	7
	3	9	6	4

Assign each person to one and only one position in such a way that the sum of ratings for all three persons is maximum. 5



8. a) Use dominance to reduce the pay-off matrix and solve the game with the following pay-off matrix

	B ₁	B ₂	B ₃	B ₄
A ₁	3	2	4	0
A ₂	3	4	2	4
A ₃	4	2	4	0
A ₄	0	4	0	8

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- b) Solve graphically the game having the following payoff matrix :

8

	B ₁	B ₂
A ₁	1	- 3
A ₂	3	5
A ₃	- 1	6
A ₄	4	1
A ₅	2	2
A ₆	- 5	0

9. A project consists of the following activities, the details of which are given below :

Activity	Duration (In Weeks)		
	Most Likely	Optimistic	Pessimistic
(1, 2)	1	1	7
(1, 3)	4	1	7
(1, 4)	2	2	8
(2, 5)	1	1	1
(3, 5)	5	2	14
(4, 6)	5	2	8
(5, 6)	6	3	15



- a) Draw a network diagram for this project. Find the critical path, the expected project completion time. Also, determine the total float and free float of each activity.
- b) If the project's due date is 15 weeks, what is the probability that the project will be completed within the due date ?

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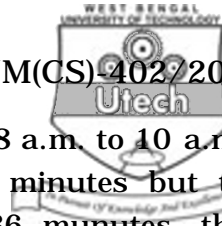
(Given, $P(0 \leq z \leq 0.67) = 0.4082$)

10. Consider the details of a distance newtork as shown beloe :

Arc	Distance
1 - 2	3
1 - 3	8
1 - 4	10
2 - 3	4
2 - 4	7
3 - 4	2
3 - 5	8
4 - 5	6

- i) Construct the distance network.
- ii) Apply Floyd's algorithm to determine the shortest path and the corresponding distance for each of the following :
 - a) From node 1 to node 5
 - b) From node 2 node 5.

5 + 10



11. a) If for a period of 2 hours in the day (8 a.m. to 10 a.m.) trains arrive at the yard every 20 minutes but the service time continues to remain 36 minutes, then calculate for this period
- i) the probability that the yard is empty
 - ii) average number of train in the system, on the assumption that the line capacity of the yard is limited to 4 trains only. 7
- b) The annual requirement for a product is 3000 units. The ordering cost is Rs. 100 per order. The cost per unit is Rs. 10. The carrying cost per unit per year is 30% of the unit cost.
- i) Find EOQ.
 - ii) By using better organizational methods the ordering cost per order is brought down to Rs. 80 per order, but the same quantity as determined above was ordered. If a new EOQ is found by using the ordered cost as Rs. 80, what would be further saving in the cost ? 8
12. a) A branch of a nationalized bank has only one typist. Since typing work varies in length (number of pages to be typed), the typing rate is randomly distributed approximating a Poisson distribution with a mean service rate of 8 letters per hour. The letter arrives at a rate of 5 per hour during the entire 8-hour work-day. If the typist is valued at Rs. 1.50 per hour, determine :
- i) equipment utilization
 - ii) the per cent time an arriving letter has to wait
 - iii) average system time
 - iv) average idle time cost of the typewriter per day. 7

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b) Use duality to solve the following LPP :

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$$\text{Maximize } Z = 4x_1 + 2x_2$$

subject to

$$x_1 + x_2 \geq 3$$

$$x_1 - x_2 \geq 2$$

$$x_1, x_2 \geq 0.$$

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