



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.TECH(CSE)/SEM-4/M(CS)-402/2010**

**2010**

**OPERATION RESEARCH & OPTIMIZATION  
TECHNIQUES**

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.*

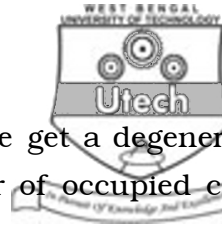
Graph sheet(s) to be supplied by the Institute.

**GROUP – A**

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for any *ten* of the following :  
10 × 1 = 10

- i) An activity is said to be ..... if a delay in the start of the course makes a delay in the completion time of the entire project.
  - a) non-critical
  - b) critical
  - c) delay
  - d) all of these.
- ii) The set  $S = \{ x^2 + y^2 < 25 : (x, y) \in R \}$  is a
  - a) Convex set
  - b) Concave set
  - c) Non-convex set
  - d) Non-concave set.
- iii) In a transportation problem ..... method gives the closest initial basic feasible solution to the optimal basic feasible solution
  - a) NWC
  - b) MMM
  - c) VAM
  - d) MODI.



- iv) In an  $m \times n$  transportation problem we get a degenerate basic feasible solution if the number of occupied cells are
- a)  $m + n - 1$                       b) less than  $m + n - 1$   
c) more than  $m + n - 1$       d)  $m - n$ .
- v) Assignment problem is solved by
- a) Stepping stone method  
b) Two phase method  
c) Hungarian method  
d) Karmakar's Algorithm.
- vi) If the primal problem has an unbounded solution then the solution to the dual problem will be
- a) unbounded                      b) unique  
c) multiple                      d) infeasible.
- vii) A queuing model is generally expressed using
- a) Fulkerson's Notation  
b) Newton's Notation  
c) Dantzing's Notation  
d) Kendall's Notation.
- viii) Which of the following set is not convex set ?
- a)  $x = \{ (x_1, y) : |x| \leq 3, |y| \leq 2 \}$   
b)  $x = \{ (x_1, y) : 5x - y = 4 \}$   
c)  $x = \{ (x_1, y) : 2x - y \leq 3 \}$   
d)  $x = \{ (x_1, y) : x^2 + y^2 = 5 \}$ .



- ix) A basic solution of the system of equations  
 $2x_1 + x_2 - x_3 = 2, 3x_1 + 2x_2 - x_3 = 3$  is
- a) ( 1, 1, 1 )                      b) ( 1, 1, 0 )  
 c) ( 1, 0, 0 )                      d) none of these.
- x) The Canonical form of L.P.P. can be written in matrix form as
- a) Max  $Z = c x$   
 Sub to,  $Ax \leq b$   
 $x \leq 0$
- b) Max  $Z = c x$   
 Sub to,  $Ax \leq b$   
 $x \leq 0$
- c) Min  $Z = c x$   
 Sub to,  $Ax \leq b$   
 $x \geq 0$
- d) Min  $Z = c x$   
 Sub to,  $Ax \geq b$   
 $x \geq 0$ .
- xi) For a  $m \times n$  degenerate Transportation problem the number of occupied cells is
- a) less than (  $m + n - 1$  )  
 b) greater than (  $m + n - 1$  )  
 c) less than equal to (  $m + n - 1$  )  
 d) equal to (  $m + n - 1$  ).
- xii) A game is solved graphically when the pay off matrix is of the form
- a)  $m \times 1$                       b)  $m \times n$   
 c)  $m \times 2$                       d)  $n \times m$ .



xiii) The formula for probability of  $n$  units in the system under single server, FCFS discipline is

a)  $P_n = \left( \frac{\lambda}{\mu} \right)^n P_o, P_o = 1 - \lambda/\mu$

b)  $P_n = \left( \frac{\lambda}{\mu} \right)^{n-1} P_o, P_o = 1$

c)  $P_n = \left( \frac{\lambda}{\mu} \right)^{n+1} P_o, P_o = 1$

d)  $P_n = \left( \frac{\lambda}{\mu} \right)^n P_o, P_o \neq 1.$

xiv) The state is referred as explosive state if

a)  $\left( \frac{\lambda}{\mu} \right) > 1$                       b)  $\left( \frac{\lambda}{\mu} \right) < 1$

c)  $\left( \frac{\lambda}{\mu} \right) = 1$                       d)  $\left( \frac{\lambda}{\mu} \right) > 0.$

### GROUP – B

#### ( Short Answer Type Questions )

Answer any *three* of the following.  $3 \times 5 = 15$

2. Solve the game whose pay-off matrix is given by

#### Player B

		$B_1$	$B_2$	$B_3$
<b>Player A</b>	$A_1$	1	3	1
	$A_2$	0	-4	-3
	$A_3$	1	5	-1

3. Solve the following by graphical method

Maximize  $Z = 4x_1 + 7x_2$

subject to

$2x_1 + 5x_2 \leq 40,$

$x_1 + x_2 = 11,$

$x_2 \geq 4,$

$x_1, x_2 \geq 0.$



4. Obtain the dual of the following L.P.P :

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

subject to

$$x_1 + x_2 + 4x_3 \geq 7,$$

$$x_2 - 2x_3 \geq 10,$$

$$3x_1 + x_2 + x_3 \geq 3,$$

$$x_1, x_2, x_3 \geq 0.$$

5. Find the optimal assignment for the assignment problem with the given cost matrix

	I	II	III	IV
A	10	9	7	8
B	5	8	7	7
C	5	4	6	5
D	2	3	4	3

6. Determine EOQ in an inventory control problem having
- Constant rate of demand
  - Instantaneous replenishment and
  - Finite rate of production.
7. Food X contains 6 unit of vitamin A & 7 unit of vitamin B per gram and costs 12p/gm. Food Y contains 8 units and 12 units of A and B per gram respectively and costs 20 p/gm. The daily requirement of vitamin A & B are at least 100 units & 120 units respectively. Formulate the above as a L.P.P. to minimize the costs.



**GROUP – C**

**( Long Answer Type Questions )**

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

8. a) Use duality to solve the LLP,

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

Subject to

$$2x_1 + 3x_2 \geq 2,$$

$$x_1 + x_2 \geq 1,$$

$$x_1, x_2 \geq 0.$$

- b) Solve graphically the game having the following pay of matrix

	B1	B2	B3	B4
A1	2	2	3	-1
A2	4	3	2	6

7 + 8

9. a) A television repairman find that the time spent on his jobs has an exponential distribution with a mean of 30 minutes. If he repairs the sets in the order in which they came in and if the arrival of sets follows a Poisson distribution with an approximate average rate of 10 per 8-hours day, what is the repairman's expected idle time each day ? How many jobs are ahead of the average set just brought ?

- b) Solve the following LLP :

$$\text{Max } X = x_1 + x_2$$

Subject to

$$3x_1 + 2x_2 \leq 5,$$

$$x_2 \leq 2,$$

$$x_1, x_2 \geq 0.$$

6 + 9



10. a) Solve the transportation problem by VAM :

	I	II	III	$a_i$
1	8	7	3	60
2	3	8	9	70
3	11	3	5	80
$b_j$	50	80	80	

Also verify whether the solution obtained by VAM is optimal or not ? Find optimal solution, if the above solution is not optimal.

- b) Solve the following LPP,

$$\text{Maximize } Z = 6x_1 + 10x_2$$

$$\text{Subject to } 3x_1 + 5x_2 \leq 10,$$

$$5x_1 + 3x_2 \leq 15$$

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

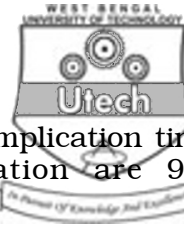
8 + 7

11. a) Construct a network for the project whose activities and precedence relationship are as given below :

Activities	A	B	C	D	E	F	G	H
Immediate Predecessor	—	A	A	B	B, C	E	D, F	G

- b) The time of each activity of the network is given in  $t_o - t_m - t_p$  form, where  $t_o$  is the optimistic time,  $t_p$  is the pessimistic time and  $t_m$  is most likely time.

- Determine the expected project length (  $T_{cp}$  )
- Calculate s.d. of the project length (  $\sigma$  )
- What is the percentage of confidence that the project will complete
  - at least 4 weeks earlier than expected time
  - not more than 4 weeks than the expected time ?



- iv) What should be the scheduled complication times for the probability of complication are 90% confidence and 100% confidence ?

**Dia.**

$$P ( Z \leq 1.33 ) = 0.9082$$

Given data  $P ( Z \leq 1.28 ) = 0.9$

$$P ( Z \leq 5 ) = 0.99999.$$

$$5 + 10$$

12. a) Find the shortest path from Node 1 to Node 9 of the distance network shown in the following *figure* using Dijkstra's algorithm.

**Dia.**

- b) Using Floyd's algorithm, find the shortest distances & routes between every two nodes from the network given below. The distances ( in kms. ) are given on the arcs.

**Dia.**

$$8 + 7$$

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