MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Paper Code : CS-605A

OPERATIONS RESEARCH

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 sheets will be supplied by the institution.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

   i) In non-degenerate solution of an LPP
      a) all basic variables are zero
      b) none of the basic variables are zero
      c) all basic variables are greater than or equal to zero
      d) none of these.

   ii) A transportation problem is a balanced transportation problem iff
      a) total demand and total supply are equal and number of sources equals to the number of destinations
      b) total demand equals to total supply irrespective of the no. of sources and destinations
      c) no. of sources matches with the no. of destinations
      d) the corresponding basic feasible solution is to be degenerate.

   iii) As in the simplex algorithm, the artificial variables are to go from the basis, a very small price $-M$ is assigned to each of the artificial variables in a maximization problem and a very large price $+M$ is assigned to each of the artificial variables in a minimization problem.
      a) True b) False.

   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) In a simple deterministic EOQ model, with constant demand rate (D) and infinite rate of production, the economic lot size is
      a) $\sqrt{2K/Dh}$ b) $\sqrt{2/KDh}$
      c) $\sqrt{2KDh}$ d) $\sqrt{2KD/h}$.

   vi) A queuing model is generally expressed using
      a) Newton's Notation b) Fulkerson's Notation
      c) Dantzing's Notation d) Kendall's Notation.

   vii) If the value of the objective function of an L.P.P. increases indefinitely then we say that the L.P.P. has a
      a) Degenerate solution
      b) Unbounded solution
      c) Basic feasible solution
      d) Infeasible solution.

viii) If there is no common region in the graphical method, then the LPP has

a) Unbounded solution

b) Infeasible solution

c) Many solutions

d) none of these.

ix) Multiple servers may be

a) in parallel

b) in series

c) in combination of parallel and series

d) all of these.

x) An activity (i, j) is called critical activity, if

a) $E_i = L_j$

b) $E_j = L_j$

c) $E_j - E_i = L_j - L_i = D_{ij}$

d) none of these.

xi) For a two person game with A and B, the minimizing and the maximizing players, the optimum strategies are

a) Minimax for A Maximin for B

b) Minimax for A Minimax for B

c) Minimin for A Maximin for B

d) Maximin for A Minimax for B.

xii) The process of reducing the activity duration by putting an extra effort is called crashing the activity.

a) True b) False.

GROUP – B

(Short Answer Type Questions)

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

2. Define basic solution. Define non-degenerate basic feasible solution. Find the basic solutions of the following system :

$2x + y + 4z = 11$

$3x + y + 5z = 14$

3. Solve graphically :

Minimize $Z = x + y$

subject to $5x + 9y \leq 45$

$x + y \geq 2$

$y \leq 4$

$x \geq 0$

$y \geq 0$

4. Solve the assignment problem below for minimum cost.

	A	B	C	D
M_1	5	–10	9	0
M_2	6	7	8	1
M_3	8	7	15	1
M_4	3	4	–1	4

5. The rate of use of particular raw material from stores is 20 units per year. The cost of placing and receiving an order is Rs. 40. The cost of each unit is Rs. 100. The cost of carrying inventory in per cent per year is 0·16 and it depends upon the average stock. Determine the economic order quantity and number of orders per year.

6. For the game with pay-off matrix —

	Player B		
Player A	B_1	B_2	B_3
A_1	3	4	1
A_2	–2	–3	3

determine the optimal strategies for players A and B using graphical method. Also determine the values of the game.

GROUP – C

(Long Answer Type Questions)

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

7. a) Find out the dual of the following problem :

Maximize $Z = 3x_1 + x_2 + 2x_3 - x_4$

subject to $2x_1 - x_2 + 3x_3 + x_4 = 1$

$x_1 + x_2 - x_3 + x_4 = 3$

$x_1, x_2 \geq 0$ and x_3 and x_4 is unrestricted in sign.

Show further that the dual of the dual problem is primal.

b) If the arrival rate is λ and service rate is μ, then prove that the expected queue length is $\frac{\lambda^2}{\mu(\mu-\lambda)}$.

7 + 8

8. a) A firm makes two types of furniture — chairs and tables. The profit for each product as calculated by the accounting department is Rs. 20 per chair and Rs. 30 per table. Both products are to be processed

on three machines M_1, M_2, M_3. The time required in hours by each product and total time available in hours per week on each machine is as follows :

Machine	Chair	Table	Available Time (hrs)
M_1	3	3	36
M_2	5	2	50
M_3	2	6	60

i) Give a mathematical formulation to this linear programming problem.

ii) Use the graphical method to solve this problem.

b) Solve the following LPP by Big M method :

Maximize $Z = 2x_1 + 9x_2 + x_3$

subject to $x_1 + 4x_2 + 2x_3 \geq 5$

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

$x_1, x_2, x_3 \geq 0$ (3 + 4) + 8

9. a) Find the optimal solution and the corresponding cost of transportation in the following transportation problem :

	D_1	D_2	D_3	Supply
01	8	7	3	60
02	3	8	9	70
03	11	3	5	80
Demand	80	80	80	

b) Prove that $x_1 = 1$, $x_2 = 1$, $x_3 = 1$ and $x_4 = 0$ is a feasible solution of the system of equations :

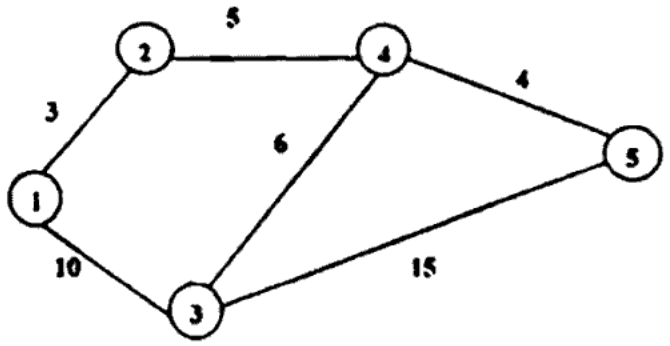
$$x_1 + 2x_2 + 4x_3 + x_4 = 7$$

$$2x_1 - x_2 + 3x_3 - 2x_4 = 4$$

Reduce the F.S. to two different B.F.S. 8 + 7

10. a) Establish an EOQ model with uniform production rate, known demand, lead time zero and no shortage. Find the optimum order quantity and optimum cost.

b) Using Floyd's algorithm find the shortest path and the length (or weight) of the shortest path of the following network between node 1 and node 5 :



11. a) A small project is composed of seven activities whose time estimates are listed in the table as follows :

	Estimated duration (weeks)		
Activity	Optimistic	Most likely	Pessimistic
1 - 2	1	1	7
1 - 3	1	4	7
1 - 4	2	2	8
2 - 5	1	1	1
3 - 5	2	5	14
4 - 6	2	5	8
5 - 6	3	6	15

You are required to

i) draw the project network. 1

ii) find the expected duration and variance of each activity. 2 + 2

iii) calculate the early and late occurrence for each event. 2 + 2

iv) calculate the variance and standard deviations of project length. $\frac{1}{2} + \frac{1}{2}$

b) For what value of λ the game with the following pay-off matrix is strictly determinable ? 5

		Player B		
		B_1	B_2	B_3
Player A	A_1	λ	6	2
	A_2	-1	λ	0
	A_3	-2	4	λ