Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (CE)/NEW/SEM-6/CE-605 A/2013

2013
OPERATION 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 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 :

$10 \times 1 = 10$

i) In an LPP, the decision variables can take

a) any real values

b) integer values only

c) any non-negative real values

d) non-negative integer values only.

ii) The maximum number of basic solutions in a system of m equations in n unknowns ($n > m$) will be

a) $m + n$ b) $n - m$

c) mn d) ${}^{n}C_{m}$.

iii) In a transportation problem, the number of cells required for forming a loop is

a) even b) odd

c) prime d) none of these.

iv) In a 'fair game' the value of the game is

a) 1 b) 10

c) 0 d) 100.

v) An assignment problem can be solved by

a) Hungarian method

b) VAM

c) Matrix minima method

d) None of these.

vi) The point of intersection of pure strategies in a game is called

a) Value of the game b) Saddle point

c) Mixed strategy d) Optimal strategy.

vii) The best method for finding the initial basic feasible solution of a Transportation problem is

a) North-West corner cell

b) VAM

c) Least-cost cell

d) Hungarian method.

viii) When there are more than one server, customer behaviour in which he moves from one queue to another is known as

a) balking b) jockeying

c) reneging d) alternating.

ix) If the primal problem has no feasible solution then the dual problem has a solution which is

a) not feasible b) unbounded

c) optimal d) basic feasible.

x) A circle is a convex set.

a) True b) False.

xi) The total float of an activity (i, j) can be evaluated by

a) $L_j - (L_i + t_{ij})$ b) $L_j - (E_i + t_{ij})$

c) $E_j - (E_i + t_{ij})$ d) $E_j - (L_i + t_{ij})$.

xii) Which costs can vary with order quantity ?

a) Unit cost only b) Holding cost only

c) Reorder cost only d) All of these.

GROUP – B

(Short Answer Type Questions)

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

2. Prove that the dual of a dual problem is a primal problem.

3. Find graphical solution (if any) of the following L.P.P. :

Maximize $Z = 3x_1 + 2x_2$

subject to $2x_1 + x_2 \leq 2$

$3x_1 + 4x_2 \geq 12$

and $x_1, x_2 \geq 0$.

4. Solve the following assignment problem :

	1	2	3	4
A	10	12	19	11
B	5	10	7	8
C	12	14	13	11
D	8	15	11	9

5. Solve the following game. The pay-off matrix is given by

		B			
		I	II	III	IV
	I	– 5	3	1	20
A	II	5	5	4	6
	III	– 4	– 2	0	– 5

6. In a railway marshalling yard, goods trains arrival time follows an exponential distribution and the service time (the time taken to load a train in the hump yard) distribution is also exponential with an average of 36 minutes. Calculate the average number of trains in the queue.

GROUP – C

(Long Answer Type Questions)

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

7. a) Solve the following LPP by simplex method :

Maximize $Z = 4x_1 + 7x_2$

subject to $2x_1 + x_2 \leq 1000$

$10x_1 + 10x_2 \leq 6000$

$2x_1 + 4x_2 \leq 2000$

$x_1, x_2 \geq 0$ 8

b) Show that $x_1 = 5$, $x_2 = 0$, $x_3 = -1$ is a basic solution of the system of equations

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

$$2x_1 + x_2 + 5x_3 = 5$$

Find the other basic solutions, if there be any. 7

8. a) Solve the transportation problem and checking the optimality, find the optimal solution :

	D_1	D_2	D_3	Supply
O_1	4	3	2	10
O_2	1	5	0	13
O_3	3	8	5	12
Demand	8	5	4	

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b) Solve the assignment problem given below for minimum cost.

Men / Machine	A	B	C	D
M_1	18	26	17	11
M_2	13	28	14	26
M_3	38	19	18	15
M_4	19	26	24	10

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9. a) Solve the following rectangular game by graphical method :

$$\begin{array}{c} \\ \text{Player A} \end{array} \begin{array}{c} \text{Player B} \\ \begin{bmatrix} 1 & 0 & 4 & 1 \\ -1 & 1 & -2 & 5 \end{bmatrix} \end{array}$$

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b) Solve the game using rule of dominance :

$$\begin{array}{c} \\ \text{Player A} \end{array} \begin{array}{c} \text{Player B} \\ \begin{bmatrix} 5 & -10 & 9 & 0 \\ 6 & 7 & 8 & 1 \\ 8 & 7 & 15 & 1 \\ 3 & 4 & -1 & 4 \end{bmatrix} \end{array}$$

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

$$\begin{array}{c} \\ \text{Player A} \end{array} \begin{array}{c} \text{Player B} \\ \begin{bmatrix} \lambda & 5 & 2 \\ -1 & \lambda & -8 \\ -2 & 3 & \lambda \end{bmatrix} \end{array}$$

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10. a) Given the following information :

Activity :	0-1	1-2	1-3	2-4	2-5	3-4	3-6	4-7	5-7	6-7
Duration (in days) :	2	8	10	6	3	3	7	5	2	8

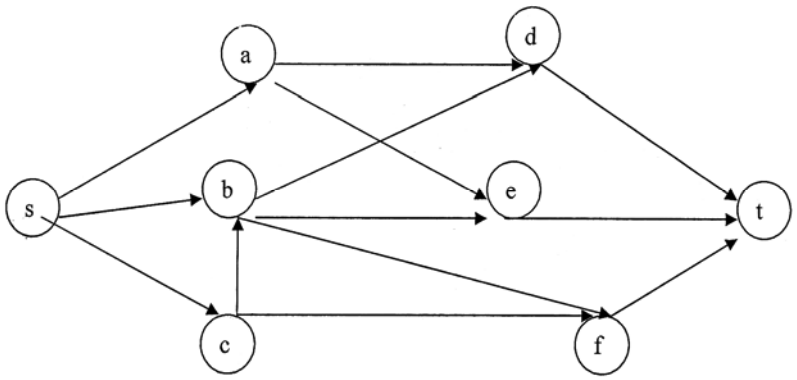
i) Draw the arrow diagram.

ii) Identify the critical path and find the total project duration.

iii) Determine total, free and independent floats.

b) Find a maximum flow in the directed network shown in the following figure and prove that it is maximum where the arc flows are as follows : 7 + 8

Arc	sa	sb	sc	ad	ae	bd	be	bf	cb	cf	dt	et	ft
Flow	2	10	8	6	6	10	3	2	5	3	4	9	10



11. a) A manufacturing company purchases 9000 parts of a machine for its annual requirement, ordering one month usage at a time. Each part costs Rs. 20. The ordering cost per order is Rs. 15 and the carrying charges are 15% of the average inventory per year. You have been assigned to suggest a more economical purchasing policy for the company. What advice would you offer and how much would it save the company per year ? 7

b) In the production shop of a company the breakdown of the machines is found to be Poisson with an average rate of 3 machines pre hour. Breakdown time at one machine costs Rs. 40 per hour to the company. There are two choices before the company for hiring the repairmen. One of the repairmen is slow but cheap, the other fast but expensive. The slow-cheap repairman demands Rs. 20 per hour and will repair the broken down machines exponentially at the rate of 4 per hour. The fast-expensive repairman demands Rs. 30 per hour and will repair machines exponentially at an average rate of 6 per hour. Which repairman should be hired ?

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