Seat No. : _______________

LD-128

April-2014

4^{th} Year, M.Sc. (CA & IT) (Integrated)

Operations Research

Time : 3 Hours] **[Max. Marks : 100**

1. Answer any **two** : **10 + 10 = 20**

(a) Explain :

(i) Basic Variable

(ii) Feasible Solution

(iii) Unbounded Solution

(iv) Multiple Optimal Solution

(v) Artificial Variable

(b) A finished product requires two raw material A and B. Per unit cost of A is ₹ 10 and B is ₹ 12. At least 14 units of B must be used and not more than 20 units of A must be used. Each unit of A and B weigh 5 and 10 grams respectively. The finished product must weigh exactly 150 grams. How much of each type of raw material should be used for each unit of final product in order to minimize the cost. Formulate it as an LPP and solve it graphically.

(c) Solve the LPP

Maximize $Z = 3x_1 + 5x_2$

Subject to $x_1 + x_2 \leq 4$

$3x_1 + 2x_2 \leq 18$

$x_1, x_2 \geq 0$

If a new variable is included in the above LPP with a profit of ₹ 7 per unit and 2 and 4 are the co-efficients of the first and second constraint respectively. Find the solution of the new problem.

2. Answer any **two** : **10 + 10 = 20**

(a) Find the optimum integer solution to the following LPP :

Maximize $Z = x_1 + 2x_2$

Subject to $2x_2 \leq 7$

$x_1 + x_2 \leq 7$

$2x_1 \leq 11$

$x_1, x_2 \geq 0$ and integers

(b) Four new machines M_1, M_2, M_3 and M_4 are to be installed. There are five places A, B, C, D and E. Cost of installation of the machines at different places are given below. Find the optimum assignment schedule.

Places → Machine ↓	A	B	C	D	E
M_1	4	3	6	2	7
M_2	10	12	11	14	16
M_3	4	3	2	1	5
M_4	8	7	6	9	6

(c) A product is produced at four factories A, B, C and D. The unit production cost in them are ₹ 3, ₹ 4, ₹ 1 and ₹ 6 respectively. Their production capacities are A → 50 units, B → 70 units, C → 30 units and D → 50 units. These factories supply the product to four stores, demand of which are 25, 35, 120 and 20 units respectively. Unit transportation cost in rupees from each factory to each store is given below. Find the optimal allocation from factories to the stores.

		Store			
		1	2	3	4
Factories	A	5	17	13	15
	B	1	11	9	16
	C	9	24	19	21
	D	6	18	9	15

3. Answer any **two** : **10 + 10 = 20**

(a) Goods truck arrives randomly at a stockyard with a mean of 8 trucks per hour. Trucks waiting in queue to be unloaded are paid a waiting charge at the rate of ₹ 60 per hour. A crew of four operatives can unload a truck in 6 minutes. Operatives are paid a wage rate of ₹ 20 per hour. It is possible to augment the crew strength to 2 or 3 (of four operatives per crew) when the unloading time will be 4 minutes or 3 minutes respectively per truck. Find the optimal crew size.

(b) The demand rate for an item in a company is 18000 units per year. The company can produce at the rate of 3000 per month. The set up cost is ₹ 500 per order and the holding cost is ₹ 0.15 per unit per month.

Calculate :

(i) Optimum manufacturing quantity

(ii) The maximum inventory

(iii) Time between orders

(c) A wholesaler dealing in stationery items wants to determine the order size for desk calendars. The demand and lead time are probabilistic and their distribution are given below :

Demand/week (thousand)	**Probability**
0	0.2
1	0.4
2	0.3
3	0.1

Lead time (weeks)	Probability
2	0.3
3	0.4
4	0.3

The cost of placing an order is ₹ 50 per order and the holding cost of 1000 calendar is ₹ 2 per week. The shortage cost is ₹ 10 per thousand. An order is placed when inventory level is less than or equal to 2000. Quantity ordered is equal to the difference between the current inventory and maximum replenishment level of 4000 units.

Simulate the system for 20 weeks :

(i) beginning inventory = 3000 units

(ii) no back order policy

(iii) each order is placed at the beginning of the week

(iv) replenishment orders are received at the beginning of the week.

Random Number for Demand : 31, 70, 53, 86, 32, 78, 26, 64, 45, 12, 99, 52, 43, 84, 38, 40, 19, 87, 83, 73

Random Number for lead time : 29, 83, 58, 41, 13, 65, 82, 15

Find the total inventory cost.

4. Answer any **two** : **10 + 10 = 20**

(a) There are five jobs which is to be processed through two machines M_1 and M_2 in the order M_1 then M_2. Processing time in hours are as follows :

Job	1	2	3	4	5
Machine M_1	3	8	5	7	4
Machine M_2	4	10	6	5	8

Determine the optimal sequence for the five jobs, total elapsed time and machine waiting time.

(b) A project schedule has the following characteristics :

Activity	**Time (days)**
1 – 2	4
1 – 3	1
2 – 4	1
3 – 4	1
3 – 5	6
4 – 9	5
5 – 6	4
5 – 7	8
6 – 8	1
7 – 8	2
8 – 10	5
9 – 10	7

Construct the network diagram. Find critical path and total project duration.

(c) A bought a car that costs ₹ 1,20,000. The resale value of the car at the end of the year is 85% of the previous year. Maintenance and operation cost during the first year is ₹ 20,000 and increase by 15% every year. The minimum resale value of the car is ₹ 40,000 when the car should be replaced ?

5. Answer any **two** : **10 + 10 = 20**

(a) Solve the following game problem. The pay off matrix for player A is given :

		Player B			
		I	II	III	IV
Player A	I	6	4	8	0
	II	6	8	4	8
	III	8	4	8	0
	IV	0	8	0	16

(b) Obtain the least square regression equation of Y on X from the following data :

X :	89	86	74	65	64	63	66	67	72	79
Y :	92	91	84	75	73	72	71	75	78	84

Forecast the value of Y when X = 70

(c) A gambler at a horse race is considering placing bet on a specific horse. There are four possible alternatives and states of nature with the following pay off :

Strategy	**A wins**	**B wins**	**C wins**	**All lose**
Bet A	7	–2	–2	–2
Bet B	3	3	–2	–2
Bet C	2	2	2	–2
Do not bet	0	0	0	0

Determine the strategy as per

(i) Maximin Criteria

(ii) Savage Regret Criteria

(iii) Hunwicz Criteria