

XU-132

April-2013

Five Years M.Sc. (CA & IT) Integrated (K.S.)**4th M.Sc.****Operations Research****Time : 3 Hours]****[Max. Marks : 100**

1. (a) A farmer owns 60 acres of land. He is going to plant each acre with paddy or cash crop. Profit per acre planted with paddy will be ₹ 8,000, whereas profit per acre planted with cash crop will yield ₹ 14,000. The labour and fertilizer used for each acre are given below : 10

	Paddy	Cash Crop
Labour (workers)	3	2
Fertilizer (in tons)	2	4

One hundred workers and 120 tons of fertilizer available. Farmer tries to maximize the profit. Formulate it as an LP problem and solve it graphically.

- (b) Write down the dual of the following LP problem : 5
- Maximize $7x_1 + 6x_2 - 2x_3$
- Subject to $4x_1 - 2x_2 + 3x_3 \leq 10$
- $x_2 + x_3 = 8$
- $5x_1 + 4x_2 + 7x_3 \leq 16$
- $x_1, x_2 \geq 0, x_3$ unrestricted
- (c) Write a short paragraph on sensitivity analysis. 5

OR

- (a) A company produces two products A and B from three raw materials R_1 , R_2 and R_3 . Currently 40 kg of R_1 , 24 kg of R_2 and 40 kg of R_3 are available. One unit of product A sells for ₹ 200 and requires 1 kg of R_1 , 1 kg of R_2 and 2 kg of R_3 . One unit of product B sells for ₹ 250 and requires 2 kg of R_1 , 1 kg of R_2 and 1 kg of R_3 . Company is able to sell whatever the quantity of products A and B is produced. Company is interested to maximize its total revenue. Obtain the optimal solution and find the following : 15
- (i) Find the range of values for the price of product A for which the current basis remain optimal.
- (ii) Find the range of values for the amount available for R_1 for which the current basis remain optimal.

- (b) Explain : 5
- (i) Infeasibility
- (ii) Unboundedness
- (iii) Degeneracy in LPP.

2. (a) A company has four factories situated in different locations in the country and four sales agencies located in four other regions. The cost of production (₹ per unit), the shipping cost (₹ per unit), the selling price at the sales agencies (₹ per unit) and the monthly factory capacities and requirements are given below : 15

Sales Agency →

Factory	1	2	3	4	Supply	Production cost
A	7	5	6	4	10	10
B	3	5	4	2	15	15
C	4	6	4	5	20	16
D	8	7	6	5	15	15
Requirement	8	12	18	22		
Selling price	23	22	25	21		

Find the optimal solution and allocation.

- (b) Define the following : 5
- (i) Integer Programming Problem
- (ii) Unbalanced Transportation Problem

OR

- (a) A service organisation has to finish six tasks in a particular period and only five persons are available. The cost matrix is shown below : 15

Person

	1	2	3	4	5
1	23	29	27	20	28
2	34	31	23	26	29
Task 3	29	26	27	25	29
4	31	32	28	31	28
5	29	31	22	32	27
6	24	27	25	28	27

If one task can be given to only one person and one person can take only one task. How to assign the task to person to minimize the overall cost.

- (b) Describe briefly : 5
- (i) Constrained Assignment Problem
- (ii) Cutting Plane Technique.

3. Attempt any **two** : **10 × 2 = 20**

- (a) Workers come to the tool storeroom to receive special tools required by them for accomplishing a particular project assigned to them. The average time between two arrivals is 60 seconds. The average service time of the tool room attendant is 40 seconds. If arrivals follow Poisson and service is exponentially distributed. Determine the following :
- (i) Average queue length
- (ii) Average length of non-empty queues

- (iii) Average number of workers in the system.
 (iv) Average waiting time of an arrival in the system.
 (v) Determine whether to go for an additional storeroom attendant, which will minimize the combined total cost of the attendant's idle time and the worker side time if the charges of a worker is ₹ 4 per hour and that of the storeroom attendant is ₹ 0.75 per hour. [Assuming that both can give service together to a customer in 20 seconds.]
- (b) A company has a demand of 15000 units per year for an item and it can produce 2000 items per month. The cost of one setup is ₹ 400 and the holding cost per unit per month is ₹ 0.15. Find the optimum lot size and the total cost per year if the cost of each unit is ₹ 4. Also find the maximum inventory, manufacturing time and total cycle time.
- (c) Observations of past data show the following pattern in respect to inter arrival duration and service duration in a single channel queuing system. Simulate the queuing behaviour for a period of 60 minutes and estimate the probability of the service being idle and the mean time spent by a customer waiting for service :

Inter Arrival Time		Service Time	
Minutes	Probability	Minutes	Probability
2	.15	1	.10
4	.23	3	.22
6	.35	5	.35
8	.17	7	.23
10	.10	9	.10

Random Number for arrival : 93, 14, 72, 10, 21, 81, 87, 90, 38, 10, 29

Random Number for service : 71, 63, 14, 53, 64, 42, 07, 54, 66, 21, 49

4. Attempt any **two** :

10 × 2 = 20

- (a) Consider the following game problem, where pay off matrix of player A is given; solve the problem optimally :

		Player B's strategy			
		1	2	3	4
Player A's strategy	1	2	-2	4	1
	2	6	1	12	3
	3	-3	2	0	6
	4	2	-3	7	7

- (b) The research department of a beauty care product has recommended marketing department to launch a shampoo of three different types. The marketing manager has to decide one of the types of shampoo to be launched under the following estimated payoff (in million ₹) for various level of sales :

Types of shampoo	Estimated level of sale (units)		
	15000	10000	5000
Egg shampoo	30	10	10
Daily shine	40	15	5
Damage Repair	55	20	3

What will be marketing manager's decision if

- (i) Maximin
- (ii) Laplace
- (iii) Savage Regret
- (iv) Hurwicz criteria is used.

- (c) On January 1 (this year) Bakery A had 40% of its local market share while the other two bakeries B and C had 40% and 20% respectively of the market share. Based upon a study by a marketing research firm, the following facts were compiled. Bakery A retains 90% of its customers while gaining 5% of competitor B's customer and 10% of competitor C's customer. Bakery B retains 85% of its customers while gaining 5% of A's customer and 7% of C's customer. Bakery C retains 83% of its customers and gain 5% of A's and 10% of B's customer. What will each firm's share be on January 1, next year and what will each firm's market share be at equilibrium.

5. Attempt any **two** :

10 × 2 = 20

- (a) Given the following information :
- (i) Draw the Network
 - (ii) Calculate total float and free float
 - (iii) Find the critical path

Activity :	A	B	C	D	E	F	G	H	I	J
Predecessor activities :	-	-	A, B	B	A	C	E, F	D, F	G, H	I
Duration :	2	3	4	1	5	3	2	7	6	3

- (b) Find the sequence that minimizes the total elapsed time required in completing the jobs given below, the order of processing the jobs remains the same i.e. A → B → C. Find machine idle time and job waiting time besides the total elapsed time :

Job →							
Machine ↓	J ₁	J ₂	J ₃	J ₄	J ₅	J ₆	J ₇
A	10	8	12	6	9	11	9
B	6	4	6	5	3	4	2
C	8	7	5	9	10	6	5

- (c) The following failure rate has been observed for a certain type of transistors in a digital computer. The cost of replacement of the transistors individually on failure is ₹ 15 per unit. If the group replacement cost is ₹ 8 per unit and initially there are 2000 transistors. Justify which replacement policy is better.

End of Week :	1	2	3	4	5	6	7	8
Probability of failure :	0.07	0.11	0.25	0.41	0.79	0.88	0.96	1.0