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RF-4804

M. C. A. (Sem. - II) Examination

April / May – 2010

Paper - 204 : Computer Based Optimization Techniques

(Old & New Course)

Time : **3** Hours] [Total Marks : **70**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ M. C. A. - 2

Name of the Subject :

☛ 204 - COMPUTER BASED OPTIMIZATION TECHNIQUES

☛ Subject Code No. : 4 8 0 4 ☛ Section No. (1, 2,.....) : NIL

Seat No. :

Student's Signature

(2) The marks for each question is given in right side of each question.

(3) All questions carry equal marks.

Answer the following questions:

1.a. Define the following terms in relation to linear programming: [6]
(i) Basic feasible solution, (ii) Slack variable,
(ii) Optimum solution, (iv) Associated cost vector.

1.b. Solve the following linear programming problem: [8]

Minimize $z = x_1 - 3x_2 + 2x_3$,

subject to
$$3x_1 - x_2 + 3x_3 \leq 7,$$
$$-2x_1 + 4x_2 \leq 12,$$
$$-4x_1 + 3x_2 + 8x_3 \leq 10,$$
$$x_1 \geq 0, x_2 \geq 0, x_3 \geq 0.$$

OR

1.b. Solve the following linear programming problem: [8]

Maximize $z = 6x_1 + 8x_2 + 4x_3 + 3x_4$,

subject to
$$2x_1 + 3x_2 + x_3 \leq 900,$$
$$x_2 + 2x_3 \leq 600,$$
$$3x_1 + 2x_2 + 2x_3 \leq 1200,$$
$$3x_3 + x_4 = 100,$$
$$x_1 \geq 0, x_2 \geq 0, x_3 \geq 0, x_4 \geq 0.$$

2.a. A manufacturer produces three models (I, II,III) of a certain product. He uses two types of raw materials (A and B) of which 4000 and 6000 units respectively are available. The raw material requirements per unit of the three models are given below: [6]

Raw Material	Requirement per unit of given model I	II	III
A	2	3	5
B	4	2	7

The labour time for each unit of model I is twice that of model II and three time that of model III. The entire labour force of the factory can produce can produce the equivalent of 2500 units of model I. A market survey indicates that the minimum demand of the three models are 500, 500 and 375 units respectively. However, the ratios of the number of units produced must be equal to 3:2:5. Assume that the profit per unit of model I, II and III are Rs. 60, 40 and 100 respectively. Formulate the problem as linear programming problem in order to determine the number of units of each product which will maximize profit.

2.b. Obtain the optimum solution for the following transportation problem: [8]

	Warehouses W_1	W_2	W_3	W_4	W_5	Available
F_1	4	3	1	2	6	40
Factory F_2	5	2	3	4	5	30
F_3	3	5	6	3	2	20
F_4	2	4	4	5	3	10
Required	30	30	15	20	5	

OR

2.b. Obtain the optimum solution for the following transportation problem: [8]

	Warehouses 1	2	3	4	5	6	Available
1	5	3	7	3	8	5	3
2	5	6	12	5	7	11	4
From City 3	2	8	3	4	8	2	2
4	9	6	10	5	10	9	8
Required	3	3	6	2	1	2	

3.b. A certain equipment needs five repair jobs which have to be assigned to five machines. The estimated time (in hours) that each machine requires to complete the repair job is given in the following table: [7]

		Job				
		1	2	3	4	5
Machine	1	7	5	9	8	11
	2	9	12	7	11	10
	3	8	5	4	6	9
	4	7	3	6	9	5
	5	4	6	7	5	11

Assuming that each machine can be assigned to only one job, determine the minimum time assignment.

3.b. Find an optimal sequence for the following sequencing problem of 5 jobs and 4 machines when passing is not allowed of which processing time (in hours) is given below: [7]

Jobs :	1	2	3	4	5
Machine M_1 :	10	12	8	15	16
Machine M_2 :	3	2	4	1	5
Machine M_3 :	5	6	4	7	3
Machine M_4 :	14	7	12	8	10

Also find total elapsed time.

OR

3.a. Solve the following traveling salesman problem. [7]

		To				
		1	2	3	4	5
From	1	∞	17	16	18	14
	2	17	∞	18	15	16
	3	16	18	∞	19	17
	4	18	15	19	∞	18
	5	14	16	17	18	∞

3.b. Find the optimal sequence for the following sequencing problem of 4 jobs and 5 machines when passing is not allowed of which processing time in (hours) is given below:

Jobs :	1	2	3	4
Machine M_1 :	6	5	4	7
Machine M_2 :	4	5	3	2
Machine M_3 :	1	3	4	2
Machine M_4 :	2	4	5	1
Machine M_5 :	8	9	7	5

Also find the total elapsed time.

4.a. Define the following terms: [4]

(i) Earliest finish time (ii) Pessimistic time

(iii) Estimated time (iv) Successor activity

4.b. The following table gives the activity times (in days) for a small project: [10]

Activity	Optimistic Time	Most Likely Time	Pessimistic Time
1 - 2	1	2	9
2 - 3	1	4	7
2 - 4	2	4	12
3 - 5	2	3	4
3 - 7	6	8	15
4 - 5	4	6	8
4 - 6	3	5	7
5 - 6	5	1	15
5 - 7	5	7	15
6 - 7	3	5	13

(i) Construct the network.

(ii) Compute earliest and latest times for each activity.

(iii) Find the critical path and its duration.

(iv) What is the probability that the project should be completed in 25 days?

OR

4.a. Define the following terms: [4]

(i) Critical path (ii) Critical activity

(iii) Merge event (iv) Cost slope.

4.b. The following table gives the data on normal time, normal cost, crash time and crash cost for a small project. [10]

Activity	Time (days)		Cost (Rs.)	
	Normal	Crash	Normal	Crash
1 - 2	6	4	1400	1900
1 - 3	8	5	2000	2800
2 - 3	4	2	1100	1500
2 - 4	3	2	800	1400
3 - 4	0	0	0	0
3 - 5	6	3	900	1600
4 - 6	10	6	2500	3500
5 - 6	3	2	500	800

Indirect cost is Rs. 300 per day.

(i) Draw the network.

(ii) Find the critical path.

(iii) Find the optimum project time and corresponding minimum total cost by crashing appropriate activities in proper order.

5.a. Define different types of costs associated with inventory control. [4]

5.b. Consider a shop which produces three items. The items are produced in lots. The demand rate for each item is constant and can be assumed to be deterministic. No back logs are to be allowed. The pertinent data for the items are given below: [4]

Product	:	1	2	3
Annual demand (Units/year)	:	11000	140000	8500
Holding cost/ unit (Rs.)	:	30	30	30
Set-up Cost per lot (Rs)	:	60	50	70

Determine approximately the economic order quantities when the average inventory level of these items is 1050.

5.c. A baking company sells one of its type of cake by weight. If the product is not sold on the day it is prepared, it can be sold at a loss of 15 paise per Kg. and there is an unlimited market for one day old cake. The company makes a profit of 95 paise on every Kg. of cake sold on the day it is prepared. Past daily orders form a distribution with density function: [3]

$$f(x) = 0.02 - 0.0002x, \qquad 0 \le x \le 100.$$

How many Kg. of cake should the company prepare every day?

5.d. Find the optimum order quantity for a product for which the breaks are as follows: [3]

Quantity Range	Purchasing cost
$0 \le Q < 400$	Rs. 145.00 per unit
$400 \le Q < 800$	Rs. 135.00 per unit
800 and above	Rs. 130.005 per unit

The monthly demand for the product is 4500 units. The monthly holding cost is 2% of the unit cost of the product and the cost of ordering is Rs. 700.00 per month.

OR

5.a. Find the optimum order quantity for a product for which the breaks are as follows: [4]

Quantity Range	Purchasing cost
$0 \le Q < 250$	Rs. 8.00 per unit
$250 \le Q < 450$	Rs. 7.50 per unit
$450 \le Q < 650$	Rs. 7.00 per unit
650 and above	Rs. 6.75 per unit

The monthly demand for the product is 900 units. The monthly holding cost is 20% of the unit cost of the product and the cost of ordering is Rs. 45.00 per month.

5.b A machine shop produces three products 1,2 and 3 in lots. The shop has a warehouse whose total floor area is 350 sq. meters. The relevant data for the three items are given below: [4]

Product	:	1	2	3
Annual demand (Units/year)	:	4000	3000	8000
Holding cost/unit (Rs.)	:	15	20	10
Set-up cost per lot (Rs.)	:	90	180	70
Floor area required (sq. meters)	:	0.70	0.85	0.45

The carrying charge on each item is 20% of the average inventory valuation per annum. No stock outs are allowed. Determine the optimal lot size for each item.

5.c. The demand of an item is uniform at a rate of 30 units per month. The set-up cost is Rs. 20 each time a production run is made. The inventory carrying cost is Rs. 0.45 per item per month. If the shortage cost is Rs. 2.25 per item per month, determine how often to make a production run and of what size it should be? [3]

5.d. The probability distribution of monthly sales of a certain item is as follows: [3]

Monthly Sales:	40	41	42	43	44	45	46	47	48	49	50	51
Probability :	0.03	0.05	0.05	0.10	0.15	0.15	0.12	0.10	0.10	0.07	0.06	0.02

The cost of carrying inventory is Rs. 1.80 per unit per month and the cost of unit shortage is Rs. 3.20 per month. Determine the optimum stock level which minimizes the total expected cost.
