BITS, Pilani-Dubai Campus
Knowledge Village, Dubai

Date: 26/09/04 Test : I(CB) Course: Optimization
COURSE No. AAOCUC222
Duration :50 min Total Marks : 20 Weightage: 20

NOTE : (Answer all Questions)

Q1. [6]

A company has 3 Operational Departments (weaving processing and packing) with a capacity to produce 3 different types of clothes namely suiting, shirting and woolens, yielding a profit of Dhs2, Dhs4 and Dhs3 per meter respectively. One meter of suiting requires 3 minutes in weaving, 2minutes in processing and 1minute in packing. Similarly One meter of shirting requires 4 minutes in weaving, 1minute in processing and 3 minutes in packing One meter of woolen requires 3 minutes in each department . In a week total run time of each department is 60,40and 80hrs respectively for weaving, processing and packing. Formulate a LPP to maximize the profits.

Q2. [4+3]

(a)Draw the graph of the following problem and find the optimal solution

$\max x_0 = 2x_1 + 3x_2$
subject to

$3x_1 + 2x_2 \le 6$
$-x_1 + x_2 \le 0$
$x_1, x_2 \ge 0$

(b) If the above problem is changed to $\max x_0 = c_1x_1 + c_2x_2$ with the same constraints then find the range of $\frac{c_1}{c_2}$ *or* $\frac{c_2}{c_1}$ so that the same solution remains optimal.

[7]

Q3.

Use simplex method to solve the following problem

$$\max x_0 = 12x_1 + 3x_2 + x_3$$

subject to the constraints

$$10x_1 + 2x_2 + x_3 \leq 100$$
$$7x_1 + 3x_2 + 2x_3 \leq 77$$
$$2x_1 + 4x_2 + x_3 \leq 80$$
$$x_1, x_2, x_3 \geq 0$$

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Date: 7/11/04 Test : Open Book Course: Optimization
Duration : 50 min Total Marks : 20 Weightage: 20

NOTE : (Answer all Questions)

Q1.Given **[10]**

Max $x_0 = 2x_1 + x_2 + 4x_3 - x_4$

Sub to

$2x_1 + x_2 + 4x_3 - x_4 \leq 8$

$2x_1 + x_2 + 4x_3 - x_4 \leq 0$

$2x_1 + x_2 + 4x_3 - x_4 \leq 21$

where $x_1, x_2, x_3, x_4 \geq 0$

If for the above problem the optimal table is given as

	x_0	x_1	x_2	x_3	x_4	s_1	s_2	s_3	Sol^n
x_0	1	0	1/2	1/2	0	2	3/2	0	16
x_1	0	1	1/2	5/2	0	1	3/2	0	8
x_4	0	0	-1/2	1/2	1	0	1/2	0	0
s_3	0	0	1	-5	0	-2	-2	1	5

Then

(a)If the b column is changed to $\begin{pmatrix} 3 \\ -2 \\ 4 \end{pmatrix}$ **in the original problem what is the new optimal solution ?**

(b)If the cost coefficient of x_1 is changed to 1 in the original problem what is the new optimal solution ?

(c) If the second constraint is removed from the original problem what is the new optimal solution ?

(d) If x_1 is deleted from all the constraints from the original problem what is the new optimal solution ?

(e)Form the dual of the above problem (do not solve the dual problem)

Q2. [10]

In a company, it is required to deliver a product from three sources S_1, S_2, S_3 to four destinations D_1, D_2, D_3, D_4 .The sources have the following amounts in stock

S_1 6 units

S_2 3 units

S_3 3 units

The customers demands are

D_1 3 units

D_2 4units

D_3 2 units

D_4 3 units

The costs of transporting one unit of the product from the different sources S_1, S_2, S_3 to destinations D_1, D_2, D_3, D_4 are given below .

	D_1	D_2	D_3	D_4
S_1	3	7	6	4
S_2	2	4	3	2
S_3	4	3	8	5

Find the optimal cost of transportation.(Apply the u-v method only once)

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Comprehensive Examination –III Year –Fifth Semester 2004-2005

Date 2/01/05
Duration : 3 hours

Course:Optimization
Total Marks : 40
Weightage : 40%

NOTE : (Answer all Questions)

Q1 **[2×4]**

(a)Solve the following problem using Graphical method

max $x_o = x_1 + x_2$

subject to the conditions

$3x_1 + x_2 \leq 3$

$-3x_1 + x_2 \geq 3$

$x_1, x_2 \geq 0$

(b) Solve the game whose payoff matrix is given by

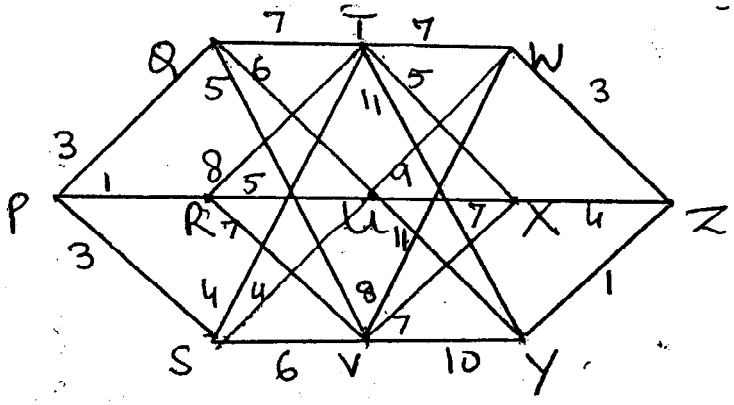
		Player Y	
		1	-3
		3	5
Player X		-1	6
		4	1
		2	2
		-5	0

What is the game value ?

(c)A product is produced by 4 factories A,B,C,D and the product capacity of these factories are 50,70,30,50 units respectively.The product is supplied to four stores P,Q,R,S requirements of which are 25,35,105and 20 respectively .The unit cost of transportation is given below in the table . Use Vogels Method and find the optimal solution for the above Transportation problem

4	6	8	13
13	11	10	8
14	4	10	13
9	11	13	8

(d) Find the shortest route from node P to node Z in the following network.



Q2 [4+4]

(a) The owner of Metro sports wishes to determine how many advertisements to place in the selected three monthly magazines A, B, C. His objective is to advertise in such a way so that total exposure to principal buyers of expensive sports good is maximized. Readers for each magazine are known. Exposure in any particular magazine is the number of advertisements placed multiplied by the number of principal buyers. The following data may be used

	Magazines		
	A	B	C
Readers	1 lakh	0.6 lakh	0.4 lakh
Principal Buyers	20 %	15%	8%
Cost/Advertisement	Rs 8000	Rs 6000	Rs 5000

The budgeted amount is atmost Rs 1 lakh for the advertisements .The owner has already decided that magazine A should have no more than 15 advertisements and that B and C each have at least 8 advertisements . Formulate the LPP

(b) Formulate the Dual of the following problem

$$\text{Max } x_o = 4x_1 + 2x_2$$

subject to the conditions

$$-x_1 - x_2 \le -3$$

$$-x_1 + x_2 \le -2$$

$$x_1, x_2 \ge 0$$

and find the solution of the dual , will the primal have a feasible solution ? Explain your answer.

Q3

(a) Use Dynamic programming to show [4+4]

$$x_1 \log x_1 + x_2 \log x_2 + x_3 \log x_3,$$

subject to

$$x_1 + x_2 + x_3 = 1$$

where $x_1, x_2, x_3 \ge 0$

is min when $x_1 = x_2 = x_3 = \frac{1}{3}$

(b)A company plans production on three of their products A,B,C .The unit profit on these products are Rs10, Rs6 , Rs 4, resp and they require three resources namely technical, labor and administration. The companies Operations Research Department is given requirements on each of the resourses for the three products as follows

	RESOURSES		
PRODUCT	TECHNICAL	LABOR	ADMINISTRATION
A	1	10	2
B	1	4	2
C	1	5	6

There are 100 hours of technical services available,600 hours of labor and 300 hours of administration. OR team formulates the following linear programming model for determining the maximum profit

max $x_o = 10x_1 + 6x_2 + 4x_3$

subject to the conditions

$x_1 + x_2 + x_3 \le 100$

$10x_1 + 4x_2 + 5x_3 \le 600$

$2x_1 + 2x_2 + 6x_3 \le 300$

$x_1, x_2, x_3 \ge 0$

where x_1, x_2, x_3 are number of products of each type. The optimal table for the above problem is given below

	x_0	x_1	x_2	x_3	s_1	s_2	s_3	Sol^n
x_0	1	0	0	+16/6	+20/6	+4/6	0	4400/6
x_2	0	0	1	5/6	10/6	-1/6	0	400/6
x_1	0	1	0	1/6	-4/6	1/6	0	200/6
s_3	0	0	0	4	-2	0	1	100

(i) If coefficient of x_1 in the objective function is changed to 5 ,how does the value of x_o change.

(ii)If the company decides to produce a new product requiring 1 hour of technical service,4 hours of labor and 3 hours of administration .The marketing division predicts that the product can be sold for a profit of Rs 8 per unit .What should be the managements decision ?.

Q4. **[4+4]**

(a)Use Branch and Bound technique to solve the following problem

Max $x_o = 2x_1 + 3x_2$

subject to the conditions

$5x_1 + 7x_2 \leq 35$

$4x_1 + 9x_2 \leq 36$

$x_1, x_2 \geq 0$

(b)A company has two machines for manufacturing a product .Machine 1 makes 3 units per hour where machine 2 makes 5 per hour . The company has an order of 100 units. Energy restrictions dictate that only one machine can operate at one time.The company has 60 hours of regular machine time but overtime is available. It costs Rs 4 to run machine 1 for an hour where machine 2 costs Rs 5 per hour .The companys goals are

meet the demand of 100 units exactly
limit machine overtime to 10 hours
use the 60 hours of normal machine time
minimize cost

formulate the above problem taking penalties to be 1 in each case(only formulation required)

Q5 [4+4]

(a) Solve the non linear programming problem

$$\text{Max} \quad -x_1^2 - x_2^2 - x_3^2 + 4x_1 + 6x_2$$

subject to the conditions

$$x_1 + x_2 \le 2$$

$$2x_1 + 3x_2 \le 12$$

$$x_1, x_2 \ge 0$$

using Kuhn Tucker Method (The solution should satisfy all conditions of the method including $x_i, \lambda_i \ge 0$ for all i)

(b) The following Table provides the cost and time estimate for a project consisting of eight activities .

(i) Draw the network

(ii)Find the Critical path and normal project duration .Also show free float and total float time are 0 for the activities on the critical path.

(iii) Crash the duration of the project by 2 days , what is then the cost of the project?

Activity i-j	Normal duration (days)	Crash Duration (days)	Normal Cost (Rs)	Crash Cost (Rs)
1-2	6	4	600	1000
1-3	4	2	600	2000
2-4	5	3	500	1500
2-5	3	1	450	650
3-4	6	4	900	2000
4-6	8	4	800	3000
5-6	4	2	400	1000
6-7	3	2	450	800