BITS, Pilani-Dubai Campus
Knowledge Village, Dubai

Comprehensive Examination –III Year –Fifth Semester 2003-2004

Date 5/01/04
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 $x_o = 6x_1 + x_2$

subject to the conditions

$2x_1 + x_2 \geq 3$

$-x_1 + x_2 \geq 0$

$x_1, x_2 \geq 0$

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

Player Y

Player X

	P	Q	R
A	1	3	1
B	0	-4	-3
C	1	5	-1

What are the best strategies for X and Y .Also give the game value .

(c) Use Vogels Method and find the optimal solution for the following Transportation problem

	X	Y	Z	R	
A	3	7	6	4	5
B	2	4	3	2	2
C	4	3	8	5	3
	3	3	2	2	

(d) Solve the following assignment problem

	U	V	W	X
A	18	26	17	11
B	13	28	14	26
C	38	19	18	15
D	19	26	24	10

Q2 **[4+4]**

(a) A firm manufactures 3 products A,B,C . The profits are Rs 3, Rs 2, Rs 4 resp The firm has 2 machines and below is the required processing time in minutes for each machine on each product

	Products		
	A	B	C
Machine G	4	3	5
Machine H	2	2	4

Machine G and H have 2000 and 2500 machine minutes resp. The firm must manufacture 100 A ,200 B and 50 C , but no more than 150 A . Formulate the LPP

(b) Solve the following problem

Max $x_o = 5x_1 - 4x_2 + 3x_3$

subject to the conditions

$2x_1 + x_2 - 6x_3 = 20$

$6x_1 + 5x_2 + 10x_3 \leq 76$

$8x_1 - 3x_2 + 6x_3 \leq 50$

$x_1, x_2, x_3 \geq 0$

Q3 [4+4]

(a) Use Dynamic programming to solve

$$\min\ x_1^2 + 2x_2^2 + 4x_3,$$

subject to

$$x_1 + 2x_2 + x_3 \geq 8$$

where $x_1, x_2, x_3 \geq 0$

(b)A company plans production on three of their products A,B,C .The unit profit on these products are Rs2, Rs 3 , Rs 1, resp and they require two resources labor and material. The companies Operations Research Department formulates the following linear programming model for determining the optimal product mix

$$\max\ x_o = 2x_1 + 3x_2 + x_3$$

subject to the conditions

$$\frac{1}{2}x_1 + \frac{1}{2}x_2 + \frac{1}{2}x_3 \leq 1$$

$$\frac{1}{2}x_1 + 2x_2 + \frac{7}{2}x_3 \leq 2$$

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

the optimal table for the above problem is given below

	x_0	x_1	x_2	x_3	s_1	s_2	Sol^n
x_0	1	0	0	3	10/3	2/3	14/3
s_1	0	1	0	-1	8/3	-2/3	4/3
x_2	0	0	1	2	-2/3	2/3	2/3

(i) If coefficient of x_1 in the objective function is changed to -1 ,how does the value of x_o change.

(ii) If b column is changed to $\begin{pmatrix} 5 \\ 6 \end{pmatrix}$ what is the value of new x_o.

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

$$6x_1 + 5x_2 \leq 25$$

$$x_1 + 3x_2 \leq 10$$

$$x_1, x_2 \geq 0$$

and are integers

(b)A firm produces two products X and Y.Product X sells for a net profit of Rs 80 per unit, while product Y sells for a net profit of Rs 40 per unit. The goal of the firm is to earn Rs 900 in the next week .Also the management wants to achieve sales volume for the two products close to 17 and 15 resp .Formulate the above problem as a goal programming problem and solve .

[4+4]

Q5

(a) Solve the non linear programming problem

$$\text{Min} \quad 2x_1^2 + 2x_2^2 - 24x_1 - 8x_2 + 2x_3^2 - 12x_3 + 200$$

subject to the conditions

$$x_1 + x_2 + x_3 = 11$$

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

(b) The following Table provides the relevant information for a project consisting of eight activities .

(i) Draw the network

(ii)Find the Critical path ,normal project duration and variation.

Activity	Immediate predecessor	t_o	t_m	t_c
A	-	1	1	7
B	-	1	4	7
C	-	2	2	8
D	A	1	1	1
E	B	2	5	14
F	C	2	5	8
G	D,E	3	6	15
H	F,G	1	2	3

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NOTE : Answer all Questions

Q1 [2×4]

(a)Solve the following problem

$$\max \; x_o = 5x_1 + 3x_2$$

subject to the conditions

$$2x_1 + x_2 \le 1$$

$$x_1 + 4x_2 \ge 6$$

$$x_1, x_2 \ge 0$$

Using any method.

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

Player Y

Player X

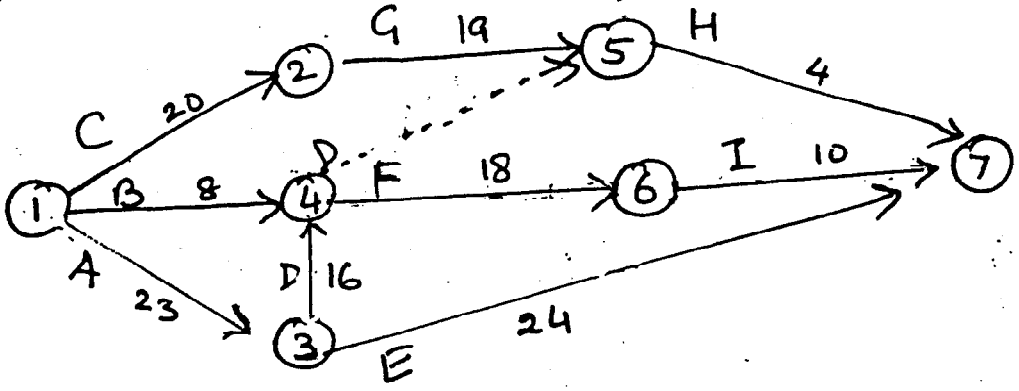
1	7
6	2

What is the game value ?

(c)A departmental head has four subordinates A,B,C,D and three jobs X,Y,Z to be perfomed. He assesses number of hours each man would take to perform each job which are given below in the matrix . How should the job be assigned so that the total time is minimized

	X	Y	Z
A	9	26	15
B	13	27	6
C	35	20	15
D	18	30	20

(d) Find the shortest route from node 1 to node 7 in the following network.



Q2 [4+4]

(a) Three grades of coal A,B,C contain ash and phosphorus as impurities .In a particular industrial process a fuel obtained by blending the above grades containing not more than 25% ash and 0.03% phosphorus is required .The maximum demand of fuel is 100 ton . Percentage impurities and costs of various grades of coal are shown below .Assuming that there is an unlimited supply of each grade of coal and there is no loss in blending .Formulate the blending problem to minimize the cost .

Coal Grade	%Ash	%Phosphorus	Cost/ton in Rs
A	30	0.02	240
B	20	0.04	300
C	35	0.03	280

(b) Formulate the Dual of the following problem

Max $x_o = 2x_1 + x_2$

subject to the conditions

$x_1 + 2x_2 \le 10$

$x_1 + x_2 \le 6$

$x_1 - x_2 \le 2$

$x_1 - 2x_2 \le 1$

$x_1, x_2 \ge 0$

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

Q3

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

$$\text{Max } x_o = y_1 y_2 y_3$$
$$y_1 + y_2 + y_3 = 5,$$
$$y_1, y_2, y_3 \geq 0$$

(b) If for a problem the optimal table is given as

	x_0	x_1	x_2	s_3	s_2	a_1	Sol"
x_0	1	0	0	3/5	29/5	-2/5	141/5
x_2	0	0	1	-1/5	2/5	-1/5	8/5
x_1	0	1	0	7/5	1/5	2/5	9/5

Given s_2 is a slack variable and a_1 is an artificial variable then if a new variable x_4 is added with the cost 30 and coefficient of x_4 in the constraints are 5 and 7 then find the next optimal table .

Q4.

(a)Use Branch and Bound technique to solve the following problem [4+4]

Max $x_o = 9x_1 + 7x_2$

subject to the conditions

$3x_1 - x_2 \leq 6$

$x_1 + 7x_2 \leq 35$

$x_1, x_2 \geq 0$

and are integer

(b)The objective is to maximize Max $x_o = x_1 - 2x_2$ **with a goal value 6 and subject to the constraints**

$2x_1 - x_2 \geq 2$

$x_1 + x_2 \leq 4$

$x_1, x_2 \geq 0$

Solve the above problem using goal programming .

Q5

(a) Solve the non linear programming problem using K T conditions [4+4]

Max $-x_1^2 - x_2^2$

subject to the conditions

$$-x_1 - x_2 \geq -1$$
$$-2x_1 + 2x_2 \leq 1$$
$$x_1, x_2, \geq 0$$

(b) A project consists of a series of tasks labeled A,B,C,D,E,F,G,H,I with following relationships W<X,Y means Xand Y cannot start until W is completed and X,Y< W means W cannot start until X, Yare completed .With this notation construct the network diagram having the constraints

A<D,E
B,D<F
C<G
B,G<H
F,G<I

Find the minimum time of completion of the project when time of completion of each task is as follows

A	B	C	D	E	F	G	H	I
23	8	20	16	24	18	19	4	10

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Date: 16/11/03 Test : Open Book Course: Optimization
Duration :50 min Total Marks : 20 Weightage: 20

NOTE : (Answer all Questions)

Q1

Solve the following problem [10]

Min $x_0 = 12x_1 + 20x_2$

subject to the constraints

$6x_1 + 8x_2 \geq 100$

$7x_1 + 12x_2 \geq 120$

$x_i \geq 0$

If the objective function is changed to $3x_1 + 5x_2$, what is the new optimal solution?

Q2. [10]

In a company, it is required to deliver a product from four sources S_1, S_2, S_3, S_4 to three destinations D_1, D_2, D_3 .The sources have the following amounts in stock

S_1 15 units

S_2 16 units

S_3 11 units

S_4 13 units

Total 55 units

The customers demands are

D_1 19 units

D_2 12 units

D_3 14 units

Total 45 units

The costs of transporting one unit of the product from the different sources S_1, S_2, S_3, S_4 . to destinations D_1, D_2, D_3 are given below .

	D_1	D_2	D_3
S_1	8	6	3
S_2	9	11	8
S_3	6	5	7
S_4	3	10	9

Find the minimum total cost of transportation.