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NATIONAL INSTITUTE OF TECHNOLOGY HAMIRPUR Department of Mathematics & Scientific Computing End-Semester Examination Class: B. Tech – 5th Semester

Course Title: Operations Research Maximum Marks: 50

Note: All questions are compulsory.

1(a) Apply simplex method to solve the following problem:

 $Max z = 6x_1 + 4x_2$ subject to $2x_1 + 3x_2 \le 30$ $3x_1 + 2x_2 \le 24$ $x_1 + x_2 \ge 3$ $x_1 \ge 0, x_2 \ge 0$

Does this problem have an alternate optimal basic feasible solution? If so, find it and prove that this problem has infinite optimal solutions.

Solve the following problem by using Dual simplex method:

Min
$$z = 3x_1 + x_2$$

subject to

$$x_1 + x_2 \ge 1$$

$$2x_1 + 3x_2 \ge 2$$

$$x_1 \ge 0, x_2 \ge 0$$

2(a) A manufacturer wants to ship 8 loads of his product as shown in the table. The matrix gives the mileage from (5) origin O to destination D. Shipping costs are Rs. 10 per load per mile. What shipping schedule should be used? Find the minimum mileage and minimum cost.

	D_1	D_2	D_3	Available
01	50	30	220]1
02	90	45	170	3
03	250	200	50	4
Required	4	2	2	

(b) Solve the following travelling salesman problem:

	Α	B	С	D	E
Α	8	4	7	3	4
B	4	00	6	3	4
С	7	6	8	7	5
D	3	3	7	8	7
E	4	4	5	7	8

3(a) A textile company produces two types of material A and B. The average production rates for the material A (2+4) and B are identical at 1000m/hrs. By running two shifts the operational capacity of the plant is 80 hrs/week. The marketing department reports that maximum estimated sales for the following week are 70,000 of material A and 45000 meters of material B. According to the account department the profit from one meter of material A is 5 and from one meter of material B is 3. The management of the company decide that a stable employment level is the primary goal of the firm. Thus, whenever there is a demand exceeding normal production capacity. The management simply expands production of the plant providing overtime. However management feels that overtime operation of the plant of more than 10 hours per week should be avoided because of the accelerating costs. The management has the following goals.

Goal (1) The first is to avoid any underutilization of production capacity i.e. to maintain stable employment at normal capacity.

Goal (2) To limit the overtime operation of the plant to 10 hours.

Goal (3) To achieve the sale 70,000 meters of material A and 45000 meters of material B.

Goal (4) To minimize the overtime operation of the plant as much as possible.

Formulate the problem as a Goal Programming Problem (GPP) to help the management for the best decision and solve it using Simplex method.

Course code: MA-311 Time: 3 Hours

(4+1)

(5)

(5)

Solve the following Goal Programming Problem graphically. (b)

Min. Z: $P_1d_1^- + P_2(2d_2^- + d_3^-) + P_3d_1^+$

Subject to the constraints

$$x_{1} + x_{2} + d_{1}^{-} - d_{1}^{+} = 400$$
$$x_{1} + d_{2}^{-} = 240$$
$$x_{2} + d_{3}^{-} = 300$$
$$x_{1}, x_{2}, d_{1}^{-}, d_{1}^{+}, d_{2}^{-}, d_{3}^{-} \ge 0$$

4(a) For the following game payoff matrix for player A, determine optimal strategies for both players and value of (2) the game:

		В							
		Ι	Π	III	IV	V			
	I	9	3	1	8	0			
Α	II	6	5	4	6	7			
	III	2	4	4	3	8			
	IV	5	6	2	2	1			

(b) For the following 3x3 game find optimal strategies and value of the game using principle of dominance.



(c) Transform the following games into their corresponding primal and dual LPP and hence solve by simplex (5) method or algebraic method to obtain optimal strategies and value of the game.



5 (a) The utility data for a network are given below. Draw network diagram and find critical path, duration of the project, total float, independent float and free float for each activities; (5)

		×						- 0	6.0	70
Activity	1-2	2-3	2-4	3-5	3-6	4-5	4-7	5-8	6-8	/-8
							7	5	2	8
Duration (weeks)	2	8	10	6	3	3	7	5	2	0
					1					

(b) The data for a network on normal time and normal cost as well as crash time and cost are given below. Draw network diagram and find critical path. Crash the relevant activities to determine optimal project completion time and cost. Indirect cost is Rs. 50 per week.

time and co	JSt. mui	1001 0030 13 1	0.000	2.4	2.5	25	15	5-6	6-7	6-8	7-8
Activity		1-2	2-3	2-4	2-3	5-5	4-5	5-0	0 /		
			-	7	0	5	0	6	4	13	10
Normal	Time	3	3	1	9	5	0	0			
(weeks)				*							
				100	700	250	0	320	400	780	1000
Normal	Cost	300	30	420	720	250	0	520	700	,00	1000
(Rs.)											
					-	1	0	1	3	10	9
Crash	Time	2	3	5	/	4	0	т	5	1°	
(weeks)											
		1		500	010	200	0	410	470	900	1200
Crash	Cost	400	30	580	810	1 300	0	110	1,0	1.00	
(Rs.)											
							L		1		

(4)

(3)