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7. Write short notes on the following :

- (a) Hungarian method for solving Assignment Problem
- (b) Unbalanced transportation problem with example
- (c) Two person zero sum game (5,5,5)

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(1500)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1255 C

Unique Paper Code : 32377907

Name of the Paper : Operational Research

Name of the Course : B.Sc. (H) STATISTICS DSE-1

Semester : V

Duration : 3 Hours

Maximum Marks : 75

**Instructions for Candidates**

1. Write your Roll No. on the top immediately on receipt of this question paper.
  2. Attempt any five questions.
  3. Use of non-programmable simple scientific calculator is allowed.
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1. (a) A firm plans to purchase at least 20 quintals of scrap containing high quality metal X and low quality metal Y. It decides that the scrap to be purchased must contain at least 100 quintal of X-metal and not more than 35 quintals of Y-metal.

P.T.O.

The firm can purchase the scrap from two suppliers (A and B) in unlimited quantities. The percentage of X and Y metals in terms of weight in the scrap supplied by A and B is given below:

Metals	Supplier A	Supplier B
X	25%	75%
Y	10%	20%

The price of A's scrap is Rs. 200 per quintal and that of B's is Rs. 400 per quintal. Formulate this problem as linear programming problem and solve it to determine the quantities that the firm should buy from the two suppliers so as to minimize the total purchase cost.

- (b) Use penalty (or Big M) method to solve the following L.P.P.

$$\text{Maximize } z = -2x_1 - 2x_2,$$

Subject to constraints

$$3x_1 + x_2 = 3,$$

$$4x_1 + 3x_2 \geq 6,$$

$$x_1 + x_2 \leq 4;$$

$$x_1, x_2 \geq 0 \quad (7,8)$$

- (b) Solve the following game :

		Player B					
		I	II	III	IV	V	VI
Player A	A	0	0	0	0	0	0
	B	4	2	0	2	1	1
	C	4	3	1	3	2	2
	D	4	3	7	-5	1	2
	E	4	3	4	-1	2	2
	F	4	3	3	-2	2	2

(7,8)

6. (a) Obtain an expression for the economic order quantity for price break model when shortages are not allowed.

- (b) A manufacturing company purchases 9,000 parts of a machine for its annual requirements, ordering one month usage at a time. Each part costs Rs. 20. The ordering cost per order is Rs. 15 and the carrying charges are 15% of the average inventory per year. You have been assigned to suggest a more economical purchasing policy for the company. What advice would you offer and how much would it save the company per year?

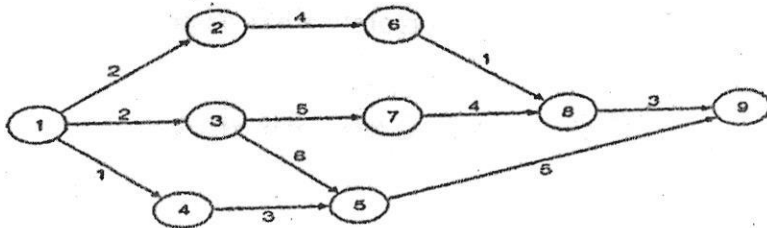
(8,7)

		Cost of Repairs (Rs. Lakhs)			
		R1	R2	R3	R4
Contractors	Roads → C1	9	14	19	15
	C2	7	17	20	19
	C3	9	18	21	18
	C4	10	12	18	19
	C5	10	15	21	16

Find the best way of assigning the repair work to the contractors that will minimize the total cost.

(8,7)

5. (a) The network below gives the permissible routes and their lengths in miles between stations of city 1 (node 1) and eight other cities (nodes 2-9).



Determine the shortest route and hence the shortest distance from city 1 to 9.

2. (a) Find the optimum solution of the problem :

$$\text{Maximize } Z = 6x_1 + 8x_2$$

Subject to constraints

$$5x_1 + 10x_2 \leq 60,$$

$$4x_1 + 4x_2 \leq 40;$$

$$x_1, x_2 \geq 0.$$

Apply sensitivity analysis to find the solution of the given L.P.P. if the right hand side vector  $[60, 40]$  of the constraints of the L.P.P. is changed to  $[40, 20]$ .

- (b) Solve the following problem by dual simplex method :

$$\text{Min } z = 3x_1 + x_2,$$

Subject to constraints

$$x_1 + x_2 \geq 1,$$

$$2x_1 + 3x_2 \geq 2;$$

$$x_1, x_2 \geq 0.$$

(7,8)

3. (a) Find the optimum solution to the following transportation problem :

		Warehouse				Capacity
		1	2	3	4	
Factory	A	21	16	25	13	11
	B	17	18	14	23	13
	C	32	27	18	41	19
Demand		6	10	12	15	

- (b) A department head has six subordinates, and six tasks to be performed. The subordinates differ in efficiency and the tasks differ in their intrinsic difficulty. His estimate of the times each man would take to perform each task is given in the effectiveness matrix below. How should the task be allocated, one to a man, so as to minimize the total man-hour.

		Subordinates					
		I	II	III	IV	V	VI
Tasks	A	9	22	58	11	19	27
	B	43	78	72	50	63	48
	C	41	28	91	37	45	33
	D	74	42	27	49	39	32
	E	36	11	57	22	25	18
	F	3	56	53	31	17	28

(8,7)

4. (a) Determine the optimal transportation plan from the following table, given the shipping cost from factory to warehouse, demand at each warehouse and capacity of each factory :

		Warehouse				Capacity
		1	2	3	4	
Factory	A	11	20	7	8	50
	B	21	16	10	12	40
	C	8	12	18	9	70
Demand		30	25	35	40	

- (b) A city corporation has decided to carry out road repairs on main four arteries of the city. The government has agreed to make a special grant of Rs. 50 lakh towards the cost with a condition that the repairs must be done at the lowest cost and thickest time. If the conditions warrant, then a supplementary token grant will also be considered favorably. The corporation has floated tenders and 5 contractors have sent in their bids. In order to expedite work, one road will be awarded to only one contractor.