[This question paper contains 6 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 8536 **HC**

Unique Paper Code : 32377907

Name of the Paper : Operational Research

Name of the Course : **STATISTICS : DSE for Honours**

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 simple calculator is allowed.

1. (a) A small jewellery manufacturing company employs a person who is highly skilled gem cutter, and it wishes to use this person at least 6 hours per day for this purpose. On the other hand, the polishing facilities can be used in any amount upto 8 hours per day. The company specializes in three kinds of semiprecious stones P, Q and R. Relevant cutting, Polishing and cost requirements are listed in the following table. How many gemstones

P.T.O.

of each type should be processed each day to minimize the cost of finished stones? What is the minimum cost?

	P	Q	R
Cutting	2 hr	1 hr	1 hr
Polishing	1 hr	1 hr	2 hr
Cost per stone	Rs. 30	Rs. 30	Rs. 10

(b) Use the principle of duality to solve the following l.p.p.:

$$\text{Min. } Z = 2x_1 + x_2 + 3x_3$$

subject to constraints :

$$2x_1 + 3x_2 + 4x_3 \geq 20$$

$$4x_1 + 2x_2 + 2x_3 \geq 15$$

$$x_1, x_2, x_3 \geq 0 \qquad (7,8)$$

(a) Consider the following linear programming problem:

$$\text{Max. } Z = 60x_1 + 80x_2$$

subject to constraints :

$$6x_1 + 5x_2 \leq 900$$

$$3x_1 + 5x_2 \leq 600$$

$$x_1, x_2 \geq 0$$

The optimal solution to the above problem is given below

Basis	x_B	x_1	x_2	x_3	x_4
x_1	100	1	0	$\frac{1}{3}$	$\frac{-1}{3}$
x_2	60	0	1	$\frac{-1}{5}$	$\frac{2}{5}$
$Z_j - C_j$	Z=10,800	0	0	-4	-12

If in the above linear programming problem another activity x_k with coefficient 65 and constraint utilization coefficients 3 and 3 are introduced then develop the new optimal solution using the concept of post optimality.

(b) Use dual simplex method to solve the following problem :

Min $Z = 10x_1 + 6x_2 + 2x_3$

subject to the constraints:

$$-x_1 + x_2 + x_3 \geq 1$$

$$3x_1 + x_2 - x_3 \geq 2$$

$$x_1, x_2, x_3 \geq 0.$$ (7,8)

3. (a) A Company has a demand of 12000 units/year for an item and it can produce 2000 such items per month. The cost of one setup is Rs. 400 and the holding cost/ unit/month is Rs. 0.15. Find the optimum lot size and the total cost per year, assuming the cost/unit is Rs. 4. Also find the maximum inventory, manufacturing time and total tune.

P.T.O.

(b) Obtain an expression for the economic order quantity for an inventory model with infinite rate of replenishment when shortages are not allowed. (7,8)

4. (a) Solve the following game whose pay-off matrix is given by :

		Player B				
		B_1	B_2	B_3	B_4	B_5
Player A	A_1	9	3	1	8	0
	A_2	6	5	4	6	7
	A_3	2	4	3	3	8
	A_4	5	6	2	2	1

(b) ABC company is engaged in manufacturing five brands of packed snacks; B_1, B_2, B_3, B_4, B_5. It is having five manufacturing set-ups; S_1, S_2, S_3, S_4, S_5, each capable of manufacturing any of its brands one at a time. The cost to make a brand (in ₹) on these set-ups vary according to the following table :

Setups / Brand	S_1	S_2	S_3	S_4	S_5
B_1	4	6	7	5	11
B_2	7	3	6	9	5
B_3	8	5	4	6	9
B_4	9	12	7	11	10
B_5	7	5	9	8	11

Obtain the optimal assignment of products on these set-ups resulting in minimum cost. (7,8)

5. (a) A bank manager had to drive daily between his residence and distant place of work. Due to heavy traffic on roads during the peak hours it became difficult for him to drive. He decided to approach a radio taxi company but before doing that he decided to determine the shortest route to the work place from his residence. The following table gives the permissible routes and their distances in kms. between his residence (node 1) and six places (node 2 to node 7). Determine the shortest route and the shortest distance from his residence (node 1) to the work place (node 7).

Nodes	1	2	3	4	5	6	7
1		11	15	20			
2				22	14		
3				15		13	
4					18	16	
5							15
6							18

(b) XYZ firm has three factories located throughout a country. The daily oil production at each factory is as follows :

Factory 1; **18 million** litres, Factory 2; 3 **million** litres, Factory 3 ; **21 million** litres.

Each day the firm must fulfil the needs of its four distribution centres. Minimum requirement at each centre is as follows :

Distribution centre 1; **21 million** litres, Distribution centre 2 ; **15 million** litres, Distribution centre 3; **9 million** litres, Distribution centre 4 ; **6 million** litres.

Cost of shipping one million litres (in ₹) from each plant to each distribution centre is given in the following table hi thousands of rupees :

Factory	Distribution Centre			
	D_1	D_2	D_3	D_4
F1	8	12	44	28
F2	4	0	24	4
F3	20	32	60	36

Obtain the optimal distribution for XYZ firm to minimize the shipping costs. (7,8)

6. Write short notes on the following :

(i) Post optimal analysis - changes affecting feasibility and optimality.

(ii) Primal dual relationship and optimal primal solution from dual.

(iii) Hungarian method for solving assignment model. (5,5,5)