7. Write short notes on the following :

   (i) Two person zero sum game.

   (ii) Canonical and standard form of linear programming.

   (iii) Primal-dual relationship and optimal primal solution from dual. (5,5,5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4610 **G**

Unique Paper Code : 32377907

Name of the Paper : Operational Research

Name of the Course : **B.Sc. (H) STATISTICS – DSE**

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.

1. (a) The manager of an oil refinery must decide on the optimum mix of 2 possible blending processes of which the inputs and outputs production runs are as follows :

Process	Input		Output	
	Crude A	Crude B	Gasoline X	Gasoline Y
1	6	4	6	9
2	5	6	5	5

The maximum amount available of crude oil A and B are 250 units and 200 units, respectively. Market demand shows that at least 150 units of gasoline X and 130 units of gasoline Y must be produced. The profit per production run from process 1 and 2 are Rs. 4 and Rs. 5, respectively. Formulate the problem for maximizing the profit. How much of each gasoline the refinery should produce in order to maximize its profit?

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

Maximize $z = 6x_1 + 4x_2$

subject to the constraints

$$2x_1 + 3x_2 \leq 30,$$

$$3x_1 + 2x_2 \leq 24,$$

$$x_1 + x_2 \geq 3;$$

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

	P_2			
P_1	8	15	-4	-2
	19	15	17	16
	0	20	15	5

By notion of dominance, reduce the game to a 2×4 game and solve it graphically. (7,8)

6. (a) Obtain an expression for the economic order quantity for an inventory model with finite rate of replenishment when shortages are not allowed.

(b) The demand for an item in a company is 18,000 units per year and the company] can produce the items at a rate of 3,000 per month. The cost of one set-up is Rs. 500 and the holding cost of 1 unit per month is 15 paise. The shortage cost of one unit is Rs. 20 per month. Determine (i) Optimum production batch quantity and the number of strategies, (ii) Optimum cycle time and production time, (iii) Maximum inventory level in the cycle, and (iv) Total associated cost per year if the cost of the item is Rs. 20 per unit. (7,8)

Find the assignment of machinists to jobs that will result in maximum profit. Which job should be declined? (8,7)

5. (a) In a travel guide map a distance (in miles) from the hotel to all the places of tourist interest (T2 to T7) is given as below in the table. Draw the network flow diagram. Obtain the shortest route and shortest distance to tourist places T6 and T7 from the hotel for the tourist.

Nodes	Hotel	T2	T3	T4	T5	T6	T7
Hotel		5	3				
T2			1	5	2		
T3				7			12
T4					3		3
T5						1	
T6				1			4

(b) The following payoff matrix represents the payoff to P_1 in a rectangular game between two persons P_1 and P_2.

2. (a) Apply the principle of duality to solve the following L.P.P. :

Maximize $z = 3x_1 + 2x_2$

subject to the constraints

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

$$x_1 + x_2 \leq 7,$$

$$x_1 + 2x_2 \leq 10,$$

$$x_2 \leq 3;$$

$$x_1, x_2 \geq 0.$$

(b) Consider the following L.P.P.:

Maximize $z = 3x_1 + 5x_2$

subject to the constraints

$$x_1 \leq 4,$$

$$3x_1 + 2x_2 \leq 18;$$

$$x_1, x_2 \geq 0.$$

The optimal solution to the above problem is given below :

Basis	x_B	x_1	x_2	x_3	x_4
x_3	4	1	0	1	0
x_2	9	3/2	1	0	1/2
$z_j - c_j$	z=45	9/2	0	0	5/2

If a new variable x_5 is introduced with $c_5 = 7$ and $a_5 = [1, 2]$; discuss the effect of adding the new variable and obtained the revised solution, if any. (7,8)

3. (a) Solve the following transportation problem :

	D_1	D_2	D_3	D_4	a_i
O_1	5	3	6	2	19
O_2	4	7	9	1	37
O_3	3	4	7	5	34
a_i	16	18	31	25	

(b) A car hire company has one car at each of five depots a, b, c, d and e. A customer in each of the five towns A, B, C, D and E requires a car. The distance (in miles) between the depots (origins) and the towns (destinations) where the customers are, is given an the following distance-matrix :

	a	b	c	d	e
A	160	130	175	190	200
B	135	120	130	160	175
C	140	110	155	170	185
D	50	50	80	80	110
E	55	35	70	80	105

How should the cars be assigned to the customers so as to minimize the distance travelled? (8,7)

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

Factory	Warehouse				Capacity
	D	E	F	G	
A	42	48	38	37	160
B	40	49	52	51	150
C	39	38	40	43	190
Demand	80	90	110	160	

(b) The owner of a machine shop has four machinists available to assign to jobs for the day. Five jobs are offered with expected profit for each machinist on each job as follows :

	Sales Territories					
Machinists		I	II	III	IV	V
	M_1	62	78	50	101	82
	M_2	71	84	61	73	59
	M_3	87	92	111	71	81
	M_4	48	64	87	77	80