[This question paper contains 5 printed pages.]

1431 *Your Roll No.* .....

B.Sc. (Hons.) / III **A**

STATISTICS – Paper XXIII

(Operational Research)

(Admissions of 1999 and onwards)

Time : 2 Hours *Maximum Marks : 38*

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt **four** *questions in all, selecting* **two** *questions from each Section.*

SECTION I

1. (a) Define bordered Hessian matrix. State the sufficient conditions for a stationary point to be an extreme point in solving general NLP problem with m equality constraints.

   (b) Solve the following NLPP :

   Min $Z = x_1^2 + 3x_2^2 + 5x_3^2$

   Subject to the constraints

   $$x_1 + x_2 + 3x_3 = 2,$$

   $$5x_1 + 2x_2 + x_3 = 5,$$

   $$x_1, x_2, x_3 \geq 0$$ (4,5½)

P.T.O.

2. Solve the following LPP :

Max $Z = 5x_1 + 10x_2 + 8x_3$

Subject to the constraints

$3x_1 + 5x_2 + 2x_3 \leq 60$ (Material in kg)

$4x_1 + 4x_2 + 4x_3 \leq 72$ (Machine hours)

$2x_1 + 4x_2 + 5x_3 \leq 100$ (Labour hours)

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

Also obtain the optimum solution of its dual problem.

Investigate the effect on the solution of the above (primal) problem of the following :

(i) An increase of 12 machine hours

(ii) A decrease of 6 kg of material (9½)

3. (a) ABC Company buys in lots of 2000 Units which is only 3 month's supply. The cost per unit is Rs. 125 and the order cost is Rs. 250. The inventory carrying cost is 20% of Unit value. How much money can be saved by using economic order quantity ?

(b) Give L.P.P.:

Max $Z = 3x_1 + 5x_2$, subject to

$x_1 \leq 4,\ 3x_1 + 2x_2 \leq 18;\ x_1 \geq 0,\ x_2 \geq 0.$

If a new activity x_3 is introduced with $C_3 = 7$ and $\underset{\sim}{a_3} = [1, 2]$, discuss the effect of adding the new activity and obtain the revised solution, if any. (4,5½)

SECTION II

4. (a) The output of a production line is checked by an inspector for one or more of three different types of defects, called defects A, B and C. If defect A occurs, the item is scrapped. If defect B or C occurs, the item must be repaired. The time required to repair a B defect is 15 minutes and the time required to repair a C defect is 30 minutes. The probabilities of an A, B and C defects are 0.15, 0.20 and 0.10 respectively. For 10 items coming of the assembly line, determine the number of items without any defects, the number scrapped and the total line of repair in minutes.

Use the following random numbers (RN) :

R.N. for defect A: 48, 55, 91, 40, 93, 01, 83, 63, 47, 52

R.N. for defect B: 47, 36, 57, 04, 79, 55, 10, 13, 57, 09

R.N. for defect C: 82, 96, 18, 96, 20, 84, 56, 11, 52, 03

(b) The owner of a small 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 :

		Jobs				
		A	B	C	D	E
Machinist	1	62	78	50	101	82
	2	71	84	61	73	59
	3	87	92	111	71	81
	4	48	64	87	77	80

Find the assignment of machinists to jobs that will result in maximum profit. Which job should be declined ? (4,5½)

5. (a) Two Companies A and B are competing for the same product. Their different strategies are given in the following pay off matrix :

		Company B		
		B_1	B_2	B_3
Company A	A_1	2	–2	3
	A_2	–3	5	–1

Use linear programming to determine the best strategies for both the players.

(b) A company has three plants at locations A, B and C which supply to warehouses located at D, E, F,

G and H. Monthly plant capacities are 800, 500 and 900 Units respectively. Monthly warehouses requirements are 400, 400, 500, 400 and 800 units respectively. Unit transportation costs (in Rs.) are given below :

		To				
		D	E	F	G	H
From	A	5	8	6	6	3
	B	4	7	7	6	5
	C	8	4	6	6	4

Determine an optimum distribution for the company in order to minimize the total transportation cost. (4,5½)

6. Write short notes on the following :

(i) Routing problem

(ii) Quadratic Programming

(iii) Degeneracy in solving transportation problem (3,3,3½)