Reg. No. : ....

Name : ....

Sixth Semester B.Sc. Degree Examination, April 2022

First Degree Programme under CBCSS

Statistics

Core Course

ST 1643 : OPERATION RESEARCH AND STATISTICAL QUALITY CONTROL

(2018 & 2019 Admission)

Time : 3 Hours   Max. Marks : 80

Instructions : Statistical tables and calculator are allowed.

SECTION – A

Answer **all** questions. **Each** question carries **1** mark.

1. Define unbounded solution.

2. Define optimum basic feasible solution.

3. When do we say that a basic feasible solution is non-degenerate?

4. What is the use of least cost method?

5. Write any method for statistical process control.

6. Write the modern definition of quality.

7. Give an example for chance cause of variation.

8. When do we use p chart?

9. Write the distribution based on which the statistical principle of c chart are underlying.

10. Write the average sample number of single sampling plan when the sample size is 100.

(10 × 1 = 10 Marks)

SECTION – B

Answer **any eight** questions. Each question carries **2** marks.

11. List the assumptions of a linear programming problem.

12. Explain the significance of artificial variable.

13. Discuss degeneracy in TPP?

14. Distinguish between slack variables and surplus variables.

15. What is meant by transportation problem?

16. Define feasible solution.

17. Write the dual of the LPP:

Maximise $Z = x_1 - x_2 + 3x_3$

Subject to

$$x_1 + x_2 + x_3 \le 10$$
$$2x_1 - x_2 - x_3 \le 2$$
$$2x_1 - 2x_2 - 3x_3 \le 6$$
$$\text{and } x_1, x_2, x_3 \ge 0$$

18. Describe an OC curve. Write any one use of OC curve.

19. What is meant by natural tolerance limits?

20. Define statistical quality control.

21. Write the control limits of range chart when the parameter values are known.

22. Describe any method to construct rational subgroups.

23. Define assignable cause of variation.

24. Define acceptance sampling.

25. Define AOQ and AOQL.

26. Distinguish between AQL and LTPD.

$(8 \times 2 = 16 \text{ Marks})$

SECTION – C

Answer **any six** questions. Each question carries **4** marks.

27. Solve the following LPP using graphical method.

    Minimize $Z = -x_1 + 2x_2$

    Subject to

    $-x_1 + 3x_2 \le 10$
    $x_1 + x_2 \le 6$
    $x_1 - x_2 \le 2$ and
    $x_1, x_2 \ge 0$

28. Discuss the mathematical formulation of a linear programming model.

29. Prove that the dual of the dual is primal.

30. Describe two phase method for solving an LPP.

31. Write the steps for solving an LPP using Big M method.

32. Compare consumer's risk and producers' risk. How do they influence the selection of control limits?

33. Discuss the statistical principle of a control chart.

34. Discuss the applications of statistical quality control techniques in industry.

35. 12 samples of 200 bulbs each were examined and the number of defective bulbs in each sample are given. Set up a control chart for fraction nonconformities using these data.

Sample Number	1	2	3	4	5	6	7	8	9	10	11	12
Number of defectives	3	2	4	3	2	0	3	1	1	2	4	0

36. Discuss the construction and applications of d chart.

37. Derive the OC function of single sampling plan. Discuss the effect of sample size and acceptance number on the OC curve of SSP.

38. Discuss the multiple sampling plan.

(6 × 4 = 24 Marks)

SECTION – D

Answer **any two** questions. Each question carries **15** marks.

39. Solve by simplex method

    Max $Z = 3x_1 + 5x_2 + 4x_3$

    Subject to

    $2x_1 + 3x_2 \leq 8$
    $2x_2 + 5x_3 \leq 10$
    $3x_1 + 2x_2 + 4x_3 \leq 15$ and
    $x_1, x_2, x_3 \geq 0$

40. Describe assignment problem. Explain the Hungarian method for solving the assignment problem.

41. Explain North West corner method and Vogel's approximation method for finding the initial feasible solution of a transportation problem.

42. Construct control chart of mean and range for the following data and comment on the state of control.

Sub group	1	2	3	4	5	6	7	8	9	10	11	12	13
x_1	459	443	457	469	443	444	445	446	444	432	445	456	459
x_2	449	440	444	463	457	456	449	455	452	463	452	457	445
x_3	435	442	449	453	445	456	450	449	457	463	453	436	441
x_4	450	442	444	438	454	457	445	452	440	443	438	457	447

    $(A_2 = 0.729, D_3 = 0, D_4 = 2.282)$

43. (a) Explain the construction of c chart and u chart.

    (b) Following table presents the number of nonconformities observed in 20 successive samples of 100 printed circuit boards. Draw a c chart for the data and comment on the state of control.

Sample Number	1	2	3	4	5	6	7	8	9	10
Number of non conformities	20	24	16	6	15	11	27	20	31	24
Sample Number	11	12	13	14	15	16	17	18	19	20
Number of non conformities	21	10	18	13	22	19	39	16	24	30

44. Compare single sampling and double sampling plans. Compute the probability of acceptance of a double sampling plan with acceptance numbers $c_1 = 1$, $c_2 = 3$ and sample sizes $n_1 = 50$, $n_2 = 100$ when the lot fraction defective is 0.05.

(2 × 15 = 30 Marks)