BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTech **SEMESTER : VI**
BRANCH: Production **SESSION: SP/2023**

SUBJECT: PE314 STATISTICAL QUALITY CONTROL

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions, each of 10 marks and total of 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data handbook/Graph paper etc. to be supplied to the candidates in the examination hall.

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Q.1(a) Which measure of central tendency and dispersion will you suggest for a sample of data containing extreme fluctuations? Why? [2]

Q.1(b) What are the components of the cost of quality? Define optimum cost of quality. [3]

Q.1(c) Why is there a difference between the formula used for calculating the standard deviation of a population and that of a sample? Find the standard deviation of group data given below: [5]

x_i	3	5	7	8	9
f_i	2	3	2	2	1

Q.2(a) When dealing with a variable quality characteristic, Why is it usually necessary to monitor both X-bar and R or S chart? [2]

Q.2(b) Explain process capability. What does it tell us? A process has a mean of 45.5 and a standard deviation of 0.9. The product has a specification of 45.0 ± 3.0. Find the process capability index(Cpk) . [2]

Q.2(c) Parts manufactured by an injection moulding process are subjected to a compressive strength test. Ten samples of five parts each are collected, and the compressive strengths in psi are shown in Table. [6]

Number	1	2	3	4	5	6	7	8	9	10
x1	83	88.6	85.7	80.8	83.4	75.3	74.5	79.2	80.5	75.7
x2	81.2	78.3	75.8	74.4	78.4	79.9	78	84.4	86.2	75.2
x3	78.7	78.8	84.3	82.5	82.6	87.3	80.8	81.5	76.2	71.1
x4	75.7	71	75.2	74.1	78.2	89.7	73.4	86	64.1	82.1
x5	77	84.2	81	75.7	78.9	81.8	79.7	74.5	80.2	74.3

i) Compute control limits for the X-bar & R chart.
ii) Compute control limits for the S chart.

For n=5: A= 1.342, A2=0.577, A3=1.427, B3=0, B4=2.089, B5=0, B6=1.964, c4=0.94, D1=0, D2=4.918, D3=0, D4=2.114, d3=0.864

Q.3(a) Consider a single sampling plan N = 1500, n = 200, c = 3. Construct the OC curve. If the acceptable quality level is 0.05% nonconforming and the limiting quality level is 6% nonconforming, describe the protection offered by the plan at these quality levels. [5]

Q.3(b) Consider a double sampling plan given by the following parameters: N=2200, n1 = 60, c1 = 0, r1 — 5, n2 = 100, c2 = 6, r2 = 7. Find the probability of accepting lots that are 3% non-conforming. What is the probability of accepting a lot on the first sample? What is the probability of making a decision on the first sample? [5]

Q.4(a) The specifications of a steel shaft are 6.40±0.10 mm. The device sometimes fails when the shaft exceeds the specification. When failure occurs, repair or replacement is necessary at an average cost of Rs.95. [5]

i) What is the loss coefficient k?
ii) What is the loss function equation?
iii) What is the loss at 6.45 mm?

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Q.4(b) The table shows you the L8 OA for predicting the weld hardness of Submerged Arc Welding (SAW) where the quality characteristic is larger-than-the-better type. In this experiment, three factors having two levels are taken that affect the weld hardness. [5]

Experiment No.	Factors		Weld Hardness
	A	B	
1	1	1	51
2	1	2	50
3	2	1	43
4	2	2	46

i) Calculate the S/N ratio for each experiment.
ii) Draw the main effects plot for S/N ratios.
iii) Determine the optimal parameter setting that enhances hardness.

Q.5(a) Define Quality circle. Explain its implementation process. [3]

Q.5(b) What is a 'Six Sigma'? Why is it assumed that the Six Sigma process would produce about 3.4 ppm defective in place of 0.002 ppm defective? [3]

Q.5(c) What is ISO? What is the main purpose of ISO 9000? List the ISO 9000 series of standards. [4]

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