

Birla Institute of Technology & Science, Pilani
First Semester 2022-23 (Comprehensive Examination - Regular)

ME F443 (QCAR)

Total Marks: 40

Date: 21/12/2022

Total Duration 3hrs

SECTION A

(CLOSE BOOK)

1 Hour

Agree or Disagree with statements given below with proper justification

[1 mark each]

Q1. Acceptance sampling scheme provides a stronger motivation to the vendor for quality improvement?

Q2. Average outgoing lot quality limit (AOQL) is the best quality received in an inspection rectification scheme.

Q3. Sampling is an important ingredient of any quality assurance program

Q4. For a quality characteristics following non-normal distribution, same mathematical formulae can be used for Statistical Process Control.

Q5. Rational subgrouping of samples is same as simple random sampling process used in variable control charts

Q6. In implementation of Attribute control chart bigger sample size is used compared to implementation of Variable control chart. Thus attribute chart will have more information content and costly to work with.

Q7. C_p value for a six sigma process is 6. Thus the percentage defective in the process is 0.001 ppm.

Q8. C_{pm} is worse measure of process performance index compared to C_{pk} .

Q9. CUSUM and EWMA charts are used in processes where small deviations in process mean is to be identified.

Q10. In scenarios where sample size (n) varies, \bar{X} -R chart and p -chart will perform best.

Q11. Conceptually U- chart and u-chart implementation for a process require same procedure.

Q12. Quality council concept was proposed by Juran for top leadership

Q13. Gage R&R study succeeds Process control and capability study

Q14. To decide whether buy/replace an existing machine, variable control chart provides necessary information.

Q15. The aspects related to Quality of Design and Quality of conformance should be dealt separately by the Organizations.

Q16. Quality control of services are simpler compared to Quality control of products.

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SECTION B

(OPEN BOOK)

2 Hour

Q1. The amount of a preservative added to dairy products should not exceed certain levels of 23 ± 5 mg (set by the Food and Drug Administration). Samples of size 6 of processed cheese produced the values of the average and range shown in Table1.

- (a) Construct appropriate control charts and determine stability of the process.
- (b) If the process is out of control, assuming remedial actions will be taken, estimate the process mean and standard deviation.
- (c) Assuming normality and a target value of 23 mg, determine the indices C_p , C_{pk} , and C_{pm}
- (d) What proportion of the dairy products meets government standards, assuming normality?
- (e) Find a 95% confidence interval for C_{pk} , assuming normality. [2+2+3+2+2]

Table1

Observation	Average Level of Preservative (mg)	Range	Observation	Average Level of Preservative (mg)	Range
1	22	5	14	22	7
2	26	4	15	20	5
3	26	6	16	24	8
4	24	7	17	25	6
5	22	3	18	23	8
6	21	5	19	20	5
7	29	7	20	22	4
8	25	8	21	22	6
9	22	4	22	23	7
10	25	6	23	24	5
11	25	9	24	22	6
12	22	3	25	25	5
13	21	5			

Q2. The number of imperfections in bond paper produced by a paper mill is observed over a period of several days. Table 2 shows the area inspected and the number of imperfections for 25 samples. Construct a control chart for the number of imperfections per square meter. Revise the limits if necessary, assuming special causes for the out-of-control points. [4]

Table 2

Sample	Area Inspected (m ²)	Imperfections	Sample	Area Inspected (m ²)	Imperfections
1	150	6	11	300	8
2	100	8	12	300	12
3	200	5	13	200	6
4	150	4	14	150	4
5	250	10	15	200	7
6	100	11	16	150	14
7	150	3	17	100	4
8	200	5	18	100	8
9	300	10	19	200	9
10	250	10	20	300	12

Q3. Determine the single sampling plans that will reject lots that are 1.3% nonconforming 8% of the time. Use acceptance numbers of 1, 3, and 5. From a consumer's point of view, which of these three plans would you choose? [4]

Q4. The cartons of 2-liter volume for lubricant used in bearing are studied in an industry. The product SD is 0.01 liter. The hypotheses $H_0 : \mu = 2$ and $H_1 : \mu \neq 2$ were investigated and H_0 was rejected under this study based on sample of 10 cartons at level of significance of 0.05. (a) Find the probability of a type II error if the true mean content is 2.005 liters. (b) With proper sketch discuss the importance of type II error observed in hypothesis testing. (c) Let the product SD is known to be 0.05 litre. If a two sided 95% confidence interval for the mean is to be established as $\pm 0.5\sigma$, determine the sample size. [2+2+2]