

Birla Institute of Technology & Science, Pilani
First Semester 2023-24 (Mid-semester Examination - Regular)

ME F443 (QCAR)

Total Marks: 30

Date: 12/10/2023

OPEN BOOK

Total Duration 1.5hrs

Q1. (a) What do you understand by the societal loss proposed by Taguchi? Discuss the steps necessary to quantify this loss. You may take the example of potable water supplied by the Public Health Engineering Department of your Municipality.

(b) The cost of repair of a failed television set in a factory is 40 dollars per unit. Let color concentration be used as the performance characteristics, y and let the customers consider the television set to be defective if y varies over the range $\tau \pm 10$, where τ is the target value of y . Find the quality loss of a customer whose television set has a color concentration of $(\tau-6)$. What kind of quality characteristics is it? [3+3]

Q2. (a) What do you understand by the statement "Quality must be inspected into the product"? Show your agreement or disagreement with the statement and justify.

(b) The diameter of a metal shaft used in a disk-drive unit, is produced from a CNC lathe. Here the dimensions are normally distributed with mean 0.2508 in and standard deviation 0.0004 in. The specification on the shaft have been established as 0.2500 ± 0.0012 in. What fraction of the shafts produced conform to specification? Suggest the shift in mean (recentering the process) by which the yield will be improved to 99%. [3+3]

Q3. (a) Discuss the three important differences between Quality Control and Quality Assurance in tabular form.

(b) What do you understand by the use of breakthrough sequence during a quality improvement project? As a line manager what strategy will you adopt to achieve success?

(c) Compare and contrast "Eliminate targets, slogans and numerical goals for the workforce" and "Zero defect program". [2+2+2]

Q4. (a) Suppose that $x_1 \sim N(\mu_1, \sigma_1^2)$ and $x_2 \sim N(\mu_2, \sigma_2^2)$ and that x_1 and x_2 are independent. Develop a procedure for constructing a $100(1-\alpha)\%$ confidence interval on $\mu_1 + \mu_2$ assuming that σ_1^2 and σ_2^2 are unknown and cannot be assumed equal.

(b) Develop a test for the hypotheses $H_0 : \mu_1 = 2\mu_2$, $H_1 : \mu_1 \neq 2\mu_2$ where σ_1^2 and σ_2^2 are known. What step will you suggest if you have σ_1^2 and σ_2^2 are unknown. [3+3]

Q5. (a) Two catalysts are analyzed to determine how they affect the mean yield of a paint manufacturing process. Specifically, catalyst 1 is currently in use, but catalyst2 is acceptable. Since catalyst2 is cheaper, it should be adopted provided it does not change the process yield. The experiment is run and results of process yield are shown in table. Is there any difference in variance in process yield and process mean yield? Use $\alpha=0.01$ and state clearly whether variances are equal or not. [4]

Obs. No	CATALYST 1	CATALYST2	Obs. No	CATALYST 1	CATALYST2
1	90.50	89.19	6	94.72	90.25
2	91.50	90.95	7	89.21	92.23
3	94.18	90.46	8	86.20	88.55
4	92.18	92.46	9	89.07	86.52
5	95.40	92.75	10	91.79	-

(b) Discuss the impact of β error (Type II error) during a statistically controlled process, when there is change in sample size and sample variability. In this case type I error value is assumed to be $\alpha=0.0023$. [2]
