

ME724 : Total Quality Management

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.
4. Statistical Tables are Permitted

Q.1A Objective type questions (10 questions @ 1 mark)

10

- i. According to Juran, anyone is customer of a product or service if that person
(a) purchases it (b) uses it (c) is affected by it (d) produces it (e) All of these

- ii. From the fig. 1. displayed below, identify the curves:

- (a) 1-cost of prevention, 2-total quality cost 3-failure cost
(b) 1-failure cost 2-total quality cost, 3-cost of appraisal+ prevention
(c) 1-Total quality cost, 2-failure cost, 3-cost of appraisal +prevention
(d) 1-Total Cost, 2-Cost of Appraisal, 3-Failure Cost

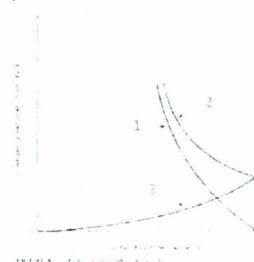


Fig. 1

- iii. The overall intention and direction of an organization with respect to Quality as formally expresses by top management is
(a) Quality plan (b) Quality objective (c) Quality Policy (d) Quality target
- iv. Consider a count variable X following a poisson distribution such that the zero count (that is $X=0$) is not observabl. Based on n observations $x_1, \dots, x_n$ from this distribution the quantity for which $\bar{x}$ is an unbiased estimator is
(a) λ (b) $1/(1-e^{-\lambda})$ (c) $\lambda / (1-e^{-\lambda})$ (d) $\lambda e^{-\lambda} / (1-e^{-\lambda})$ (e) none of these
- v. Which of the following statement is true about the ISO 9000 series?
(a) the ISO 9000 consists of 5 primary parts numbered as 9000 through 9004
(b) there are 20 elements in the ISO 9000 standards that relate to how the system operates and how well it is performing
(c) ISO 9000 places more emphasis on customer satisfaction and business results
(d) there are 3 forms of certification: first, secong and third party
- vi. Natural variations are the many sources of variation within a process that
(a) Are in statistical control (b) have several assignable causes of variation
(c) are out of control (d) are not perfect (e) none of the above
- vii. A sampling plan helps in
(a) keeping the process in control (b) keeping workers motivated
(c) turning the machines (d) adjusting ovens in the kitchen
(e) Rejecting lots that are of unacceptable quality
- viii. Which of the following chart types would be used to monitor the range of the diameter of forged steel rods within a production lot?
(a) $\bar{x}$ - bar chart (b) R - chart (c) p -chart (d) c -chart (e) none of the above

- ix. The AQL for a given sampling plan is 1.0% percent. This means that:
 - (a) the producer takes a small risk of rejecting product which is 1%
 - (b) all accepted lots are 1% defective or better
 - (c) the average quality level of the plan is 1%
 - (d) the average quality limit is 1%
- x. The main purpose of the Taguchi methods is to:
 - (a) reduce costs and prevent any unnecessary costs before producing the product or service
 - (b) articulate the 'voice of the customer'
 - (c) Test the robustness of a design
 - (d) Create a 'house of quality'

Q.2	Short answer type questions (4 questions @ 2.5 marks)	10
a	Define quality cost and give the primary categories of quality cost.	
b	Give the objectives of the attribute charts	
c	Define six sigma problem solving method	
d	What is a QFD? What are the benefits of QFD?	
Q.3A	Explain the following QC or SPC tools	05
	(a) Histogram and (b) cause and effect diagram	
Q.3B	What are the benefits of ISO14000?	05
Q.4A	What are the ten conditions for the selection and evaluation of suppliers?	05
Q.4B	Statistical monitoring of a quality characteristics uses both $\bar{x}$ and s chart. The charts are to be based on the standard values $\mu=200$ and $\sigma=10$, with $n=4$	05
	(a) Find three sigma control limits for the s chart.	
	(b) Find the center line control limits for the $\bar{x}$ chart such that the probability of a type I error is 0.05.	
Q.5A	Explain sensitizing rules for Shewhart control charts	05
Q.5B	Explain at least five reasons for control charts popularity	05
Q.6A	Construct AOQ curve for the sampling plan $N=2000$, $n=50$, $c=2$	05
Q.6B	Find a single sampling plan that satisfies a producer's risk of 5% for lots that are 1.5% nonconforming.	05
OR		
Q.6B	Explain with figure, effect of the sample size and acceptance number on the shape of the OC curve.	05
Q.7A	Construct an OC curve for a single sampling plan where the lot size is 2000, the sample size is 50 and the acceptance number is 2.	05
Q.7B	Discuss the signal-to-noise ratio. How is it used in the Taguchi method?	05
Q.8A	When do you choose the attributes charts (P charts, c charts and u charts)? explain	5
Q.8B	A Supply chain engineering group monitors shipments of materials through the company distribution network. Errors on either the delivered material or the accompanying documentation are tracked on a weekly basis. Fifly randomly	5

selected shipments are examined and the errors recorded. Data for twenty weeks are shown in Table 1. Set up a U control chart to monitor this process.

Table 1: Data on number of shipping errors in a supply chain network

Sample No. (week), i	Sample Size, n	Total no of errors (nonconformities), X_i	Sample No. (week), i	Sample Size, n	Total no of errors (nonconformities), X_i
1	50	2	11	50	8
2	50	3	12	50	2
3	50	8	13	50	4
4	50	1	14	50	3
5	50	1	15	50	4
6	50	4	16	50	1
7	50	1	17	50	8
8	50	4	18	50	3
9	50	5	19	50	7
10	50	1	20	50	4

- Q.9 a) Write the fourteen steps of Deming's philosophy for improving quality, productivity and competitiveness. 7
- b) The data in Table 2, are diameters (in mm) of holes in a group of 12 wing leading edge ribs for a commercial transport airplane. Construct and interpret a box plot of those data. 3

Table 2: Hole diameters (in mm) in wing leading edge ribs

120.5, 120.4, 120.7, 120.9, 120.2, 121.1, 120.3, 120.1, 120.9, 121.3, 120.5, 120.8

- Q.10A A manufacturer of paper used for making grocery bags is interested in improving the tensile strength of the product. Product engineering thinks that tensile strength is a function of the hard wood concentration in the pulp and that of hardwood concentrations of practical interest is in between 5% and 20% . A team of engineers responsible for the study decides to make up six test specimens at each concentration 5%, 10%, 15% and 20%. They decided to make up six test specimens at each concentration level, using a pilot plant. All 24 specimens are tested on a tensile tester, in random order. The data from this experiment are shown in Table 3. Use the analysis of variance to test the hypothesis that different hardwood concentration do not affect the mean tensile strength of the paper.

Table 3: Tensile strength of paper (psi)

HARDWOOD CONCENTRATION (%)	Observations					
	1	2	3	4	5	6
5	7	8	15	11	9	10
10	12	17	13	18	19	15
15	14	18	19	17	16	18
20	19	25	22	23	18	20

OR

- Q.10B Consider a process by which coils are manufactured. Samples of size 5 are randomly selected from the process, and the resistance values (in ohms) of the coils are measured. The data values are given in Table 4. 10

- Find sample mean's and range for respective sample sizes
- Calculate the trial control limits and construct trial X-bar & R-charts from the data given in Table 8.
- Is the process is in control? If not calculate the new control limits for X-bar & R-charts

Table 4: Coil Resistance data					
Sample	Observations	comments	Sample	Observations	comments
1	20, 22, 21, 23, 22		14	20, 21, 22, 21, 22	
2	19, 18, 22, 20, 20		15	20, 24, 24, 23, 23	
3	25, 18, 20, 17, 22	New vendor	16	21, 20, 24, 20, 21	
4	20, 21, 22, 21, 21		17	20, 18, 18, 20, 20	
5	19, 24, 23, 22, 20		18	20, 24, 22, 23, 23	
6	22, 20, 18, 18, 19		19	20, 19, 23, 20, 19	
7	18, 20, 19, 18, 20		20	22, 21, 21, 24, 22	
8	20, 18, 23, 20, 21		21	23, 22, 22, 20, 22	
9	21, 20, 24, 23, 22		22	21, 18, 18, 17, 19	High Temperature
10	21, 19, 20, 20, 20		23	21, 24, 24, 23, 23	Wrong die
11	20, 20, 23, 22, 20		24	20, 22, 21, 21, 20	
12	22, 21, 20, 22, 23		25	19, 20, 21, 21, 22	
13	19, 22, 19, 18, 19				