

THAPAR INSTITUTE OF ENGINEERING & TECHNOLOGY
END SEMESTER EXAMINATION (DECEMBER 11, 2006)
B.E. Final Year Mechanical Engineering
ME-017 Inspection & Quality Control

Time Allowed: 3 Hours

Max. Marks: 90

- NOTE:** i) Attempt any *five* questions. ii) Attempt all parts of a question at one place.
 iii) Graph paper can be asked for. iv) Assume missing data, if any suitably.
 v) Use of SQC tables is permitted.

- Q.1(a) Draw and explain organization chart for a typical Process Industry? (3)
 (b) Distinguish between Natural Tolerance Limits and Specification Limits. (3)
 (c) Using suitable example depict the production–inspection interactions and problems? (3)
 (d) Explain spiral of progress in quality? (3)
 (e) “Improving the quality of design is associated with higher cost while improving the quality of conformance is associated with lower cost” briefly discuss. (4)
 (f) Explain appraisal cost? (2)

- Q.2(a) What are the conditions under which control charts for individual and moving ranges are used? Also write the control limits for these charts. (4)
 (b) Explain the *trends* and *shifts* in the process level; also write the reasons behind these non-random patterns? (4)
 (c) The bore size on a component to be used in assembly is a critical dimension. Samples of size 4 are collected and the sample average diameter and range are calculated. After 25 such samples, we have: (10)

$$\sum_{i=1}^{25} \bar{X}_i = 107.5, \quad \sum_{i=1}^{25} R_i = 12.5$$

The specifications on the bore size are $4.4 \pm 0.2\text{mm}$. The unit cost of scrap and re-work are \$2.40 and \$0.75 respectively. The daily production rate is 1200.

- (i) Find the trial control limits for \bar{X} and R – charts.
 (ii) Assuming the process in control, estimate C_p .
 (iii) Find the total daily cost of scrap and re-work.
 (iv) If the process average shifts to 4.5mm, what is the impact on the proportion of scrap and re-work produced?

- Q.3(a) What are the advantages and disadvantages of the standardized *p*-chart as compared to regular proportion non-conforming chart? (4)
 (b) The number of non-conforming items obtained from 20 random samples are shown in the table, the corresponding sample size is also indicated, construct a standardized *p*-chart and discuss your inferences. (14)

Sample	Items Inspected	Non-conforming Items	Sample	Items Inspected	Non-conforming Items
1	50	4	11	80	6
2	90	6	12	120	8
3	100	8	13	100	20
4	90	7	14	80	5
5	80	8	15	110	8
6	40	4	16	40	6
7	50	6	17	40	4
8	50	5	18	50	7
9	110	8	19	120	5
10	70	6	20	50	4

- Q.4(a) Distinguish between the producer's risk and consumer's risk and explain the terms acceptable quality level and limiting quality level in this context. (4)
- (b) For the following two sampling plans, calculate the average total inspection for 2% and 4% defective lots and comment on the results: (6)
- Plan-I $N = 1000, n = 100, c = 1$
- Plan-II $N = 1500, n = 150, c = 2$
- (c) Design a single sampling plan that will reject the lots that are 1.3% nonconforming 8% of the times. Use acceptance numbers of 1, 3 and 5. From a consumer's point of view, which of these three plans would you choose and why? (8)

Q.5 A multiple sampling plan is as under: (18)

Sample Number	Sample Size	Acceptance Number	Rejection Number
1	50	---	3
2	50	1	3
3	50	2	4
4	50	3	5
5	50	5	6

Find the probability of acceptance of 1.5% defective lot. Assume the lot size to be large in comparison to the sample size. Also calculate the probability of rejection in each sample.

- Q.6(a) In the acceptance sampling under ANSI / ASQC Z1.4 standard, single sample is to be used with inspection level-II, an AQL of 4% and a lot size of 2500. What are the acceptance criteria under : (4)
- Normal Inspection
 - Reduced Inspection
 - Tightened Inspection
- (b) Discuss the basis on which Dodge-Romig plans are formulated, and the main objective of these plans? (3)
- (c) Explain the effect of sample size and acceptance number on shape of OC curve and protection offered by the sampling plan. (3)
- (d) Construct the operating characteristic curve for the following sampling plan : (8)
- $N = 1200, n = 50, c = 1$, if acceptable quality level is 0.5% nonconforming and limiting quality level is 8.5% nonconforming, describe the protection offered by the plan at these quality levels.
- Also construct the average outgoing quality curve for the same plan and find out AOQL.
- Q.7(a) Explain the main processes which are necessary for structural implementation of total quality program in an industrial organization, proposed by Juran. (6)
- (b) Explain the principle objectives of TQM. (3)
- (c) Describe the life-cycle of a product. What probability distribution would you use to model each phase? (4)
- (d) Explain Sequential Reliability Testing. (5)