



Attempt All Questions. Use graphics as possible. Time: 3 hours.

Marks assigned equally for each question.

**Q1:** Give a full discussion for:

- a) Variation sources and variation categories.
- b) Objectives of control charts for variables and control charts for attributes.
- c) Sample size selection in control charts for variables.
- d) Relation between control limits and specifications limits.
- e) Advantages accrue to the producer and the consumer when process is in control.

**Q2:** “Quality is not the responsibility of any one person or functional area; it is everyone’s job.” Discuss the statement through a clear sketch, complete discussion, and comments for each point.

**Q3:** Discuss the procedures for establishing control charts for variables: ( $\bar{X}$  &  $R$ ) and ( $\bar{X}$  &  $s$ ).

**Q4:** Analyze the possibilities of out-of-control conditions.

**Q4:** Give a full discussion for direct and indirect quality cost categories.

**Q5:** For lot-by-lot acceptance sampling by attributes; give: description, advantages, disadvantages, and types of sampling plans.

**Q6:** Given the following data, determine the trial control limits for each subgroup and establish the control chart. Assume that any out-of-control points have assignable causes and determine the standard value for the fraction defective for the next period.

Subgroup Number	Number Inspected	Number Defective	Subgroup Number	Number Inspected	Number Defective
1	171	31	15	165	16
2	167	6	16	170	35
3	170	8	17	175	12
4	135	13	18	167	6
5	137	26	19	141	50
6	170	30	20	159	26
7	45	3	21	181	16
8	155	11	22	195	38
9	195	30	23	165	33
10	180	36	34	140	21
11	181	38	25	162	18
12	115	33	26	191	22
13	165	26	27	139	16
14	189	15	28	181	27

**Q7:** Solve the previous Question using two methods for minimizing the effect of variable subgroup size. Give comments on your answer.

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*Best Wishes*

