[This question paper contains 4 printed pages.]

Your Roll No. .....

3200 **J**

MEM(PE)

Paper — ME.654

ADVANCED QUALITY CONTROL

Time : 3 *Hours* *Maximum Marks* : 100

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any **five** *questions.*

Use of Statistical Tables is allowed.

1. (a) Differentiate between variable and attribute control charts. What are the guidelines for selecting the various control charts ?

(b) A control chart is used to control the fraction non-conforming for a plastic part manufactured in an injection molding process. Ten subgroups yield the following data :

Sample Number	*Number Non-conforming*	*Sample Number*	*Number Non-conforming*
1	10	6	12
2	15	7	25
3	31	8	15
4	18	9	8
5	26	10	8

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Set up a control chart for the number non-conforming in samples of $n = 100$.

(c) For the chart established in part (b), what is the probability of detecting a shift in the process fraction non-conforming to 0.30 on the first sample after the shift has occurred ? 5 + 10 + 5

2. (a) Design a hypothesis to compare the process means of two different processes.

(b) Twenty rounds of standard military rifle ammunition were fired from a test weapon, resulting in a mean muzzle velocity of $\bar{X}_1 = 595$ m/s. Twenty rounds of test ammunition were also fired from the weapon, resulting in a mean muzzle velocity of $\bar{X}_2 = 600$ m/s. The sample variances were computed as $S_1^2 = 4.1$ and $S_2^2 = 5.0$, resp. Assume that muzzle velocity is normally distributed :

(i) Construct a 90% two sided confidence interval on difference in mean muzzle velocity, assuming that the variances are equal.

(ii) Construct a 95% two-sided confidence interval on ratio σ_1^2/σ_2^2.

(c) Discuss the six sigma philosophy for quality control.

5 + 10 + 5

3. (a) Define various measures of process capability. Explain how process capability accommodate the relative shift in process mean.

(b) Explain with example different approaches to estimate control chart parameters in case of variable sample size. 10 + 10

4. (a) Describe the procedure of double sampling plan. Discuss advantages and disadvantages of double sampling plan over single sampling plan.

(b) Discuss the application of correlation and regression analysis in quality control. 10 + 10

5. (a) Compare reliability evaluation using cut sets and path sets methods with a suitable example.

(b) A system has a Weibull failure distribution with a shape parameter of 1/3 and a scale parameter of 16,000. Find (i) MTTF, (ii) R (20 hrs), (iii) B 0.1 life, (iv) Variance. 10 + 10

6. (a) Define point, mission and steady state availability. Under what circumstances availability measure is preferred over reliability.

(b) Derive an expression for reliability for load sharing dependency example using Markov theory considering two identical components in active redundancy.

5 + 15

7. Write short notes on any *four* topics of the following : 5×4

(i) Operating Characteristic Curve

(ii) Interpretation of $\bar{X}$ and R charts

(iii) Latin Square

(iv) Comparison of High-level and Low-level redundancy

(v) Total Quality Management

(vi) K-out-of-*n* redundancy.