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# Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

## VI SEMESTER B.TECH (INDUSTRIAL AND PRODUCTION ENGINEERING)

## END SEMESTER EXAMINATIONS, MAY 2016

SUBJECT: QUALITY CONTROL AND RELIABILITY ENGINEERING

[MME 322]

**REVISED CREDIT SYSTEM**

Time: 3 Hours MAX. MARKS: 50

**Instructions to Candidates:**

- Answer **ANY FIVE FULL** the questions.
- Use of SQC tables permitted.
- Missing data may be suitably assumed.

**1A.** Explain the measures of dispersion. **(02)**

**1B.** Distinguish between quality of design and quality of conformance. **(03)**

**1C.** A manufacturer of electrical products purchases many parts from outside suppliers. A lot of 20000 of a certain small component is received from a new supplier. The receiving inspection department for the manufacturer has taken a random sample of 200 components from this lot and measured the resistance of each component. These resistances in ohms have been arranged into the following frequency distribution:

| Cell boundaries, ohms | Frequency |
|---|---|
| 88.5-86.5 | 2 |
| 86.5-84.5 | 5 |
| 84.5-82.5 | 16 |
| 82.5-80.5 | 24 |
| 80.5-78.5 | 40 |
| 78.5-76.5 | 44 |
| 76.5-74.5 | 25 |
| 74.5-72.5 | 22 |
| 72.5-70.5 | 13 |
| 70.5-68.5 | 7 |
| 68.5-66.5 | 2 |

Compute the average and standard deviation for this distribution. What percentage of a normal distribution having your computed estimates of $\mu$ and $\sigma$ would fall outside the specification limits 75 $\pm$ 10 ohms? **(05)**

**2A.** Explain the use of control charts for variables in quality control. **(02)**

**2B.** Write a note on inequality theorems. **(03)**

**2C.** Control charts for $\overline{X}$ and $R$, based on a subgroup size of 4, are to be used to control a process. The standard deviation of this process is 10. An aimed at value of the mean ($\overline{X}_0$) is to be 250.

(i) Determine the control limits for $\overline{X}$ and $R$ charts.

(ii) Determine the probability of a point falling within the $\overline{X}$ chart control limits if the actual $\mu$ is $0.5\sigma$ below the aimed-at value of 250.

(iii) If the actual $\mu$ is $1.0\sigma$ below 250.

(iv) If the actual $\mu$ is $2.5\sigma$ below 250. **(05)**

**3A.** Write a note on control chart for defects and defectives. **(02)**

**3B.** Explain the *α* risk and *β* risk with reference to acceptance sampling. **(03)**

**3C.** Daily inspection records are maintained on production of a special design electronic device .100 items have been inspected each day for past 21 days. A total of 546 items failed during a particular severe heat stress test. The four highest and lowest values of *p* are:

| Highest | Lowest |
|---|---|
| 0.46 | 0.18 |
| 0.33 | 0.18 |
| 0.31 | 0.20 |
| 0.31 | 0.21 |

(i) Compute the central line and 3 sigma control limits for a *p* chart. Is the process operating in control?

(ii) Recommend an aimed at value $p_0$ and 3 sigma control limits for continued use of *p* chart. **(05)**

**4A.** Explain the rationale behind using 3 sigma control limits on control charts. **(02)**

**4B.** Distinguish between statistical and conventional tolerancing. **(03)**

**4C.** A double sampling plan is $n_1$ = 25, $c_1$ = 1, $n_2$ = 50, $c_2$ = 3. Assume lot size is large in comparison with sample size. The incoming lots are 4.0 % defective. Compute:

(i) the probability of acceptance of the lot on the first sample.

(ii) the probability of rejection of the lot on the first sample.

(iii) the total probability of acceptance of the lot. **(05)**

**5A.** Explain the significance of High spots in control charts for attributes. **(02)**

**5B.** Define Precision, Accuracy and Reproducibility with regard to method of measurement. **(03)**

**5C.** A manufacturing process uses a *c* chart to control imperfections on large orders for single items. Thirty items constitute an inspection unit. After 20 inspection units have been inspected and the data recorded, the total count of imperfections is 35.

(i) Calculate the control limits for the process.

(ii) What is the probability of Type I error for this chart?

(iii) Find the probability of a Type II error should the process shift to a $\mu_c$ of 4.0. **(05)**

**6A.** Explain any two types of quality costs. **(03)**

**6B.** Explain(i) AOQ (ii) AQL(iii) ATI **(03)**

**6C.** The average clearance specified between two mating parts A and B is 0.0075 inch. The distributions of A and B are considered to be normal and, from control charting of the two parts, their respective standard deviations have been determined to be 0.0025 inch and 0.0035 inch. Assembly is at random. Perform the necessary calculations to determine the probability of interference between the two parts. **(04)**