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# MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
*A Constituent Institution of Manipal University*

**V SEMESTER B. TECH. (AUTOMOBILE ENGINEERING)**

**END SEMESTER EXAMINATIONS, DECEMBER 2017**

**SUBJECT: STATISTICAL QUALITY CONTROL & RELIABILITY (AAE 4032)**

**REVISED CREDIT SYSTEM**
**(01/01/2018)**

Time: 3 Hours MAX. MARKS: 50

**Instructions to Candidates:**

- Answer **ALL** the questions.
- Assume missing data suitably by clearly stating the assumption.
- Give sketches/graphs/examples wherever necessary.

**1A** Define quality and explain the eight dimensions of quality for a product or service of your choice and explain how they are impacting its overall acceptance by consumers. **(05)**

**1B** Explain the concept of Taguchi loss function with regard to quality. **(02)**

**1C** Brief on any two cost of quality and give two examples for each of them. **(03)**

**2A** What does the Average Run Length (ARL) of a control chart tell us? **(02)**

**2B** Distinguish between Type 1 error and Type 2 error with reference to control chart. **(02)**

**2C** State any three western electric handbook rules used for interpreting control chart patterns. **(03)**

**2D** The critical dimension of a product is specified as 25 ± 0.15 mm. During its production process that critical dimension was observed to show a mean of 24.8 mm and standard deviation of 0.08 mm and the process is under statistical control. Compute the process capability indices Cp and Cpk. **(03)**

**3A** Explain under what circumstances, a quality control engineer use **(03)**
(a) $\overline{X}$ and s chart instead of $\overline{X}$ and R chat
(b) X and $\overline{MR}$ chart
(c) c chart

**3B** Draw the nature of OC characteristic curve when (a) 100 % inspection is performed **(02)**
(b) acceptance sampling is followed

**3C** Fifteen successive heat-treated steel alloy are tested for hardness. The resulting hardness data are shown in Table below. Set up a control chart for the moving range and a control chart for individual hardness measurements. **(05)**

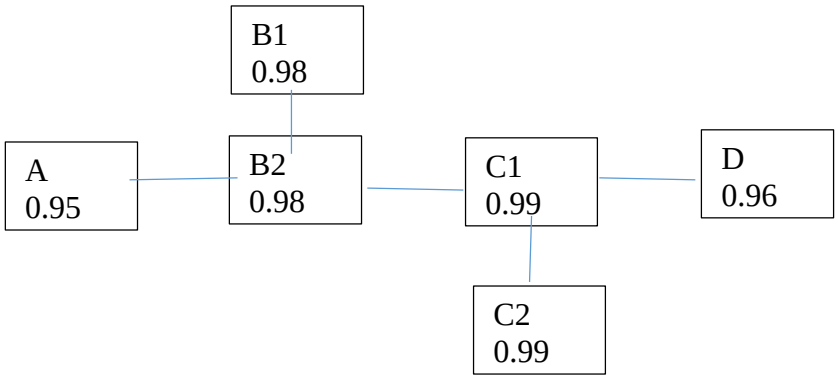
| **Sample No** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Hardness** | 52 | 51 | 54 | 55 | 50 | 52 | 50 | 51 | 58 | 51 | 54 | 59 | 53 |
| **Sample No** | **14** | **15** | | | | | | | | | | | |
| **Hardness** | 54 | 55 | | | | | | | | | | | |

**4A** A quality control engineer design a single sampling plan with sample size (n=90) and acceptance (c=3) for the acceptance sampling of a procured product from a vendor. The incoming lot size (N) is=1500.

(a) Prepare the OC curve for incoming lots of fraction defectives (p)= 0.01 to 0.08 **(02)**
(b) What is the producer's risk and consumer risk for the sampling scheme if AQL=0.02 and LTPD=0.06? **(02)**
(c) In case rectified inspection is followed, draw the AOQ curve and find AOQL for the sampling scheme. **(02)**

**4B** (i) A product is shipped in lots of size N = 2,000. Find a Dodge–Romig single-sampling plan for which the LTPD = 1%, assuming that the process average is 0.25% defective. **(02)**
(ii) MIL STD 105E is being used to inspect incoming lots of size N = 5,000. Single sampling, general inspection level II, and an AQL of 0.65% are being used. Find the normal, tightened, and reduced inspection plans. **(02)**

**5A** Find the system reliability for the following block diagram repressing a rocket guidance system with series and parallel connection. **(02)**




**5B** What is hazard function? Plot the hazard function of a product for which failure data best fit to exponential distribution. **(02)**

**5C** Define reliability and expand the salient terms involved in the definition of reliability. **(02)**

**5D** 15 sensors were tested using HALT. After 48 hours of use, seven of them are failed at times (in hours) 2.1, 8.3, 10.9, 15.2, 16.3, 20.5 and 23.8, while the remaining 8 were still functioning. Calculate the MTTF, failure rate, the time at which reliability is 95 % and the reliability after 100 hours of use. **(04)**

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