

**VIT**

Vellore Institute of Technology

**SCHOOL OF MECHANICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST (CAT) -II
FALL SEMESTER 2024-2025**

SLOT: C2+TC2

REG.NO.:

Programme Name & Branch : B.Tech & Mechanical Engineering
Course Code : BMEE212L
Course Name : Quality Control and Improvement
Faculty Name(s) : Dr.T.Sampath Kumar
Class Number(s) : VL2024250103899
Exam Duration : 90 minutes **Maximum Marks: 50**

Answer all questions**General instruction(s):**

- M - Max mark; CO - Course Outcome; BL - Bloom's Taxonomy Level (1- Remembering, 2 -Understanding, 3 - Applying, 4 - Analyzing, 5 - Evaluating and 6 - Creating)
- Course Outcomes
CO2: Demonstrate the ability to design, use, and interpret control charts for variables and attributes
CO3: Determine the process capability indices for real time processes and demonstrate Six-Sigma
CO4: Design a sampling plan to construct OC curve and evaluate its effectiveness for a given process

for a given process		M	CO	BL																																																								
Q. No	Question																																																											
1.	The following table gives the number of missing rivets (defects) noted at aircraft final inspection. <table><tr><th>Air plane No.</th><th>No. of missing rivets</th><th>Air plane No.</th><th>No. of missing rivets</th></tr><tr><td>1</td><td>8</td><td>14</td><td>25</td></tr><tr><td>2</td><td>16</td><td>15</td><td>15</td></tr><tr><td>3</td><td>14</td><td>16</td><td>9</td></tr><tr><td>4</td><td>19</td><td>17</td><td>9</td></tr><tr><td>5</td><td>11</td><td>18</td><td>14</td></tr><tr><td>6</td><td>15</td><td>19</td><td>11</td></tr><tr><td>7</td><td>8</td><td>20</td><td>9</td></tr><tr><td>8</td><td>11</td><td>21</td><td>10</td></tr><tr><td>9</td><td>21</td><td>22</td><td>22</td></tr><tr><td>10</td><td>12</td><td>23</td><td>7</td></tr><tr><td>11</td><td>23</td><td>24</td><td>28</td></tr><tr><td>12</td><td>16</td><td>25</td><td>9</td></tr><tr><td>13</td><td>9</td><td></td><td></td></tr></table> i) Compute 3 sigma trial control limits for c-chart. Drawing the graph and State whether the process is in control or not? (5 Marks) ii) Calculate the revised control limits. (5 Marks)	Air plane No.	No. of missing rivets	Air plane No.	No. of missing rivets	1	8	14	25	2	16	15	15	3	14	16	9	4	19	17	9	5	11	18	14	6	15	19	11	7	8	20	9	8	11	21	10	9	21	22	22	10	12	23	7	11	23	24	28	12	16	25	9	13	9			10	02	BL4
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2.	Calculate the following C_p, C_{pl}, C_{pu}, C_{pk}, UNTL and LNTL for the process for which the data are given below. Interpret and explain the difference between C_p and C_{pk}. Where $USL = 10.050$, $LSL = 9.950$, Mean (μ) = 9.999 and standard deviation (σ) = 0.0165.	10	03	BL4																																																								

classmate



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(Approved to be University under section 3 of UGC Act, 1956)

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3. There are 3 divisions in a company that produces electric motors. One division produces the key components of electric motors such as stators, rotors, bearings, shafts and commutator, etc.; second division provides assembling of these components. Quality control and testing is done in the third division. These 3 divisions are supported by one, common warehouse. All materials, components, supplies, and tools go through the warehouse. The problem faced by the company is with delivering right material to particular working cell on time and this made the management to do something about it. Leaders from all divisions decided to run an improving project to stabilize current situation.

Defined project goal is: To improve current 1-2 hours late deliveries to be on-time, to start production.

With the goal defined, demonstrate how the DMAIC project can be launched? Give details of implementation of each phase in brief. Explain the importance and characteristics of six sigma.

10 03 BL4

4. A machine is used to fill cans with motor oil additive. A single sample can is selected every three hours and the weight of the can is obtained. Since the filling process is automated, it has very stable variability, and long experience indicates that $\sigma = 0.05$ kg. The individual observations for 24 hours of operation are shown in below table 1.

Table 1.

Sample No.	x_i
1	8.00
2	8.01
3	8.02
4	8.01
5	8.00
6	8.01
7	8.06
8	8.07

Assuming that the process target is 8.02 kg. set up a tabular column for this process. Construct the Cusum table and give your inference, $k = \frac{1}{2}$ and $h = 5$

10 04 BL4

5. Set up an EWMA table for the sample data given below in table 2, with $\lambda = 0.25$ and $L = 3$, standard deviation is $\sigma = 1$, and the target value of the mean is $\mu_0 = 0$.

Table 2.

i	0	1	2	3	4	5	6	7
x_i	-	1.0	-0.5	0.0	-0.8	-0.8	-1.2	1.5

10 04 BL3

bar R chart

$$\bar{R} = \frac{\sum x_i}{n}$$

$$\bar{\bar{X}} = \frac{\sum \bar{x}_i}{N}$$

$$= \frac{\sum R}{N}$$

R chart

$UCL \rightarrow D_4 \bar{R}$

$LCL \rightarrow D_3 \bar{R}$

$UCL \rightarrow \bar{\bar{X}} + A_2 \bar{R}$

$LCL \rightarrow \bar{\bar{X}} - A_2 \bar{R}$

x bar s chart

$$S = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$$

$$\bar{S} = \frac{\sum S_i}{N}$$

x bar

$UCL \rightarrow \bar{\bar{X}} + 3 \left(\frac{\bar{S}}{a_n \sqrt{n}} \right)$

$LCL \rightarrow \bar{\bar{X}} - 3 \left(\frac{\bar{S}}{a_n \sqrt{n}} \right)$