B/L/TX

Reg. No: 21BME0075

VIT
Vellore Institute of Technology

Final Assessment Test – November 2024

Course: BMEE212L - Quality Control and Improvement
Class NBR(s): 3899
Time: Three Hours
Slot: C2+TC2
Max. Marks: 100

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

Answer ALL Questions
(10 X 10 = 100 Marks)

1. Explain the different types of patterns found in control charts based on natural and unnatural variations and their causes. **[10]**

2. The mean and standard deviation of 15 samples of sample size, n = 12 for a production process is given in the following table: **[10]**

Sample No	Sample Mean	Standard Deviation	Sample No	Sample Mean	Standard Deviation
1	9.5	1.2	9	8.75	2.1
2	7.5	1.5	10	9.75	3.5
3	10	2.6	11	7.25	2.6
4	8.25	3.2	12	10.25	1.1
5	7.25	1.9	13	9.25	2.2
6	9	2.6	14	10	1.6
7	10.5	5.4	15	10.5	3.2
8	9.25	2.4			

Determine the control limits for the X-bar and s-charts. Comment on whether the process variability and process mean are under statistical control or not. Use the quality control factors for n = 12 as $A_3 = 0.886$, $B_3 = 0.354$, $B_4 = 1.646$

3. In the manufacture of connecting rod assembly, the number of defectives found in the inspection of 15 samples of 50 items in each sample are given in the following table. **[10]**

Sample No.	1	2	3	4	5	6	7	8
No. of defectives	8	7	5	4	8	7	9	21
Sample No.	9	10	11	12	13	14	15	
No. of defectives	12	10	9	8	16	15	17	

Determine the control limits for the n_p-chart. Comment on whether the process is under statistical control or not. If not determine the revised control limits.

4. a) Explain the process capability analysis and its benefits. **[4]**
   b) Food served at a restaurant should be between 39°C and 49°C when it is delivered to the customer. The process used to keep the food at the correct temperature has a process standard deviation of 2°C and the mean value for these temperature is 23°C. Calculate the following Cp, Cpl, Cpu, Cpk, UNTL and LNTL for the process. Interpret the values obtained for Cp and Cpk. **[6]**

5. There are 3 divisions in a company that produces bearing. One division produces the key components of bearing such as outer rings, inner rings, rollers, cage, and housing, 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. **[10]**

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.

6. Differentiate Double, Multiple and Sequential Sampling Plans. **[10]**

7. a) Determine the MTTF for a mission time of 1000 hours life if the test data on 10 such components gave times to fail as tabulated below. Also, find the reliability of the components. **[7]**

Component No.	1	2	3	4	5	6	7	8	9	10
Time to failure in hours	807	810	820	875	900	837	850	790	866	815

b) Explain is the difference between reliability and redundancy with suitable example? **[3]**

8. Explain the bathtub curve with neat sketch with respect to product life cycle. **[10]**

9.a) The data shown in table represent individual observations on molecular weight taken hourly from a chemical process. The target value of molecular weight is $\mu_o = 0$ and the process standard deviation is thought to be about $\sigma = 1$. Set up a tabular cusum for the mean of this process. Construct the cusum table and graph also give your inference, For $k = ½$ and $h = 5$ **[10]**

Sample No.	X_i
1	1.0
2	-0.5
3	0.0
4	-0.8
5	-0.8
6	-1.2
7	1.5
8	-0.6
9	1.0
10	-0.9
11	1.2
12	0.5
13	2.6
14	0.7
15	1.1
16	2.0

OR

9.b) Set up an EWMA table and chart for the sample data given below table. Consider $\lambda = 0.25$ and $L = 3$, standard deviation $(\sigma) = 1$, and the target value of the mean $(\mu_0) = 0$. **[10]**

Sample No.	X_i
0	-
1	-1.71
2	1.20
3	0.32
4	1.03
5	-0.05
6	-0.57
7	-0.11
8	1.30
9	-0.55
10	0.37
11	1.45
12	3.08

10.a) Ten LEDs were inspected to locate defects in them. Each LED was having some defects as given below in table. Compute 3 sigma trial control limits for c-chart. Drawing the graph and state whether the process is in control or not? **[10]**

LED's	No. of Defects in the LED
1	2
2	3
3	4
4	0
5	1
6	3
7	5
8	2
9	0
10	1

OR

10.b) The following data shows the number of defects per lot in 15 successive lots of 5 radio sets each.

Lot Number	Number Inspected	Number of defects	Number of defects per unit
1	5	3	0.60
2	5	2	0.40
3	5	1	0.20
4	5	2	0.40
5	5	6	1.20
6	5	1	0.20
7	5	3	0.60
8	5	2	0.40
9	5	0	0.00
10	5	0	0.00
11	5	0	0.00
12	5	0	0.00
13	5	0	0.00
14	5	1	0.20
15	5	2	0.40

i) Plot the u-chart based on the above data and conclude whether the process is statically controlled or not. [5]

ii) If out of control happens, then revise the control limits for future production. [5]

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