



B.E DEGREE EXAMINATIONS: APRIL / MAY 2023

(Regulation 2018)

Seventh Semester

MECHATRONICS ENGINEERING

U18MCE0008: Statistical Quality Control

(Use of Statistical tables may be permitted)

COURSE OUTCOMES

- CO1:** Define the concept of probability and quality control.
CO2: Explain various sampling methods to measure quality and the attributes of quality.
CO3: Summarize the process behavior based on various control charts for variables.
CO4: Summarize the process behavior based on various control charts for attributes.
CO5: Select the appropriate samples for the study.
CO6: Apply various techniques to improve the overall quality.

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 2 = 20 Marks)

(Answer not more than 40 words)

- | | | |
|---|-----|-------------------|
| 1. List out the stages of DMAIC. | CO1 | [K ₂] |
| 2. Classify the types of probability distribution used for attribute data. | CO1 | [K ₂] |
| 3. Mention some of the prevention costs associated with the improvement of quality. | CO2 | [K ₂] |
| 4. What are the different methods to measure process variability in control charts for variables? | CO3 | [K ₂] |
| 5. Define Process capability. | CO3 | [K ₁] |
| 6. What are the most commonly used attribute charts in quality control? | CO4 | [K ₂] |
| 7. Illustrate the method of calculation control limits for p – chart? | CO4 | [K ₂] |
| 8. List out the advantages of sampling. | CO5 | [K ₂] |
| 9. What are the considerations in lot formation in sampling? | CO5 | [K ₂] |
| 10. Name some tools of quality. | CO6 | [K ₂] |

Answer any FIVE Questions:-

PART B (5 x 16 = 80 Marks)

(Answer not more than 400 words)

- | | | | |
|--|---|-----|-------------------|
| 11. a) The diameter of a metal shaft used in a disk-drive unit is normally distributed with mean 0.2508 in. and standard deviation 0.0005 in. The specifications on the shaft have been established as 0.2500 ± 0.0015 in. What fraction of the shafts produced conform to specifications? | 8 | CO1 | [K ₃] |
|--|---|-----|-------------------|

- b) Explain the internal failure and external failure costs in detail. 8 CO2 [K₂]
12. a) Select a specific product or service and discuss how the eight dimensions of quality impact its overall acceptance by consumers. 10 CO2 [K₂]
- b) Distinguish among quality planning, quality assurance, and quality control and improvement. 6 CO2 [K₂]
13. Parts manufactured by an injection molding process are subjected to a compressive strength test. Twenty samples of five parts each are collected, and the compressive strengths (in psi) are shown in Table 1. Establish X-bar and R control charts for compressive strength using these data. Is the process in statistical control? CO3 [K₃]

Table 1 Compressive Strength data

Sample number	X ₁	X ₂	X ₃	X ₄	X ₅
1	83.0	81.2	78.7	75.7	77.0
2	88.6	78.3	78.8	71.0	84.2
3	85.7	75.8	84.3	75.2	81.0
4	80.8	74.4	82.5	74.1	75.7
5	83.4	78.4	82.6	78.2	78.9
6	75.3	79.9	87.3	89.7	81.8
7	74.5	78.0	80.8	73.4	79.7
8	79.2	84.4	81.5	86.0	74.5
9	80.5	86.2	76.2	64.1	80.2
10	75.7	75.2	71.1	82.1	74.3
11	80.0	81.5	78.4	73.8	78.1
12	80.6	81.8	79.3	73.8	81.7
13	82.7	81.3	79.1	82.0	79.5
14	79.2	74.9	78.6	77.7	75.3
15	85.5	82.1	82.8	73.4	71.7
16	78.8	79.6	80.2	79.1	80.8
17	82.1	78.2	75.5	78.2	82.1
18	84.5	76.9	83.5	81.2	79.2
19	79.0	77.8	81.2	84.4	81.6
20	84.5	73.1	78.6	78.7	80.6

14. A metropolitan police agency is studying the incidence of drivers operating their vehicles without the minimum liability insurance required by law. The data are collected from drivers who have been stopped by an officer for a traffic law violation and a traffic summons issued. Data from three shifts over a ten-day period are shown in Table 2. Set up a u-chart for these data. Plot the data from Table 2 on the chart. Is the process in statistical control? CO4 [K₃]

Table 2

Sample	Number of citations	Number of drivers without insurance
1	40	4
2	35	5
3	36	3
4	57	6
5	21	1
6	35	1
7	47	3
8	43	5
9	55	8
10	78	9
11	61	4
12	32	3
13	56	5
14	43	1
15	28	0
16	50	4
17	55	6
18	67	5
19	43	3
20	58	5
21	31	1
22	27	2
23	36	3
24	87	10
25	56	4
26	49	5
27	54	7
28	68	6
29	27	1
30	49	5

15. Explain the following terms in detail: CO5 [K₂]
- (i) Single sampling plan
 - (ii) OC curve
 - (iii) Double sampling plan
16. a) Draw and explain the procedure to construct cause and effect diagram. 8 CO6 [K₂]
- b) Discuss about how FMEA is used to identify the component or system failure. 8 CO6 [K₂]
