GIET UNIVERSITY, GUNUPUR – 765022

B. Tech (Fourth Semester – Regular) Examinations, June – 2021

BPCME 4030 – QUALITY CONTROL AND RELIABILITY

(Mechanical Engineering)

Time: 2 hrs   Maximum: 50 Marks

Answer ALL Questions

The figures in the right hand margin indicate marks.

PART – A: (Multiple Choice Questions)   **(1 x 10 = 10 Marks)**

Q.1. Answer *ALL* questions

a. The output voltage of a power source is known to have a standard deviation of 10 V. Fifty readings are randomly selected yielding an average of 118 V. Find a 95% confidence interval for the population mean voltage.

(i) $105 \le \mu \le 110$ (ii) $115.228 \le \mu \le 120.772$

(iii) $120 \le \mu \le 125$ (iv) $130.456 \le \mu \le 140.256$

b. Deming's four step cycle for improvement of quality is_____.

(i) plan, do, check, act   (ii) plan, control, act, sustain

(iii) do, act, check, monitor   (iv) schedule, do, act, check

c. The process standard deviation is given by

(i) $\overline{R}/d_2$ (ii) $\overline{R}/d_3$

(iii) $1/d_2$ (iv) $\overline{x}/d_2$

d. Is there any relationship between specification limits and control limits in $\overline{x}$ and R chart?

(i) Specification limits = Control limits   (ii) Control limits = (Specification limits)/2

(iii) Control limits = 2×Specification limits   (iv) No relation at all

e. What type of charts needs to be prepared for monitoring fraction non-conforming units of a process

(i) p chart   (ii) c chart

(iii) R chart   (iv) σ chart

f. A normal distribution may be used to approximate the Poisson distribution if mean of the Poisson distribution, λ is

(i) ≥ 10 (ii) ≤ 10

(iii) <10 (iv) > 10

g. The uncontrollable factors are also called _____

(i) Noise factors   (ii) Designed factors

(iii) Sound factors   (iv) Acceptance factors

h. The sampling plan possesses greater discriminating power if sample size becomes _____ for a given value of lot size and acceptance number.

(i) larger   (ii) smaller

(iii) moderate   (iv) accurate

i. When aprocess is exactly centred between the specification limits then

(i) $C_p > C_{pk}$ (ii) $C_p = C_{pk}$

(iii) $C_p < C_{pk}$ (iv) $C_p \leq C_{pk}$

j. System reliability for components kept in series _____ as the number of components increases.

  (i) increases   (ii) remains unchanged

  (iii) decreases   (iv) can not be determined

PART – B: (Short Answer Questions)   (2 x 5 = 10 Marks)

Q.2. Answer *ALL* questions

a. How is a Binomial distribution approximated to normal distribution?

b. Explain signal-to-noise ratio.

c. Differentiate between p-chart and c-chart.

d. What do you understand by producer's and consumer's risk?

e. What is capability ratio?

PART – C: (Long Answer Questions)   (6 x 5 = 30 Marks)

Answer *ANY FIVE* questions   Marks

3. Control charts for $\bar{x}$ and R are maintained on a quality characteristic. The sample size is n = 6. After 30 samples, we obtain,   (6)

$$\sum_{i=1}^{30} \bar{x}_i = 6000 \text{ and } \sum_{i=1}^{30} R_i = 150$$

Find the three-sigma limits for the $\bar{x}$ and R chart.

Assume that both charts exhibit control. If the specifications are 200±5, what are your conclusion regarding process capability?

4. A control chart for the number nonconforming is to be established based on samples of size 400. To start the control chart, 30 samples were selected and the number nonconforming in each sample determined yielding $\sum_{i=1}^{30} D_i = 1200$.   (6)

What are the parameters of the np chart? Suppose the process average fraction nonconforming is shifted to 0.15, what is the probability that the shift would be detected on the first subsequent sample?

5. Samples of n=6 items are taken from a manufacturing process at regular intervals. A normally distributed quality characteristic is measured and $\bar{x}$ and S values are calculated for each sample. After 50 subgroups have been analysed, we have   (6)

$$\sum_{i=1}^{50} \bar{x}_i = 1000 \text{ and } \sum_{i=1}^{50} S_i = 75$$

Compute the control limits for $\bar{x}$ and S charts. If the specification limits are 19 ± 4, what is your conclusion regarding the ability of the process?

6. The following data represent the number of nonconformities per 100 m² of fabric from a textile mill. Construct a c-chart for the number of nonconformities.   (6)

Sample Number	Number of Nonconformities	Sample Number	Number of Nonconformities
1	5	14	11
2	4	15	9

3	7	16	5
4	6	17	7
5	8	18	6
6	5	19	10
7	6	20	8
8	5	21	9
9	16	22	9
10	10	23	7
11	9	25	5
12	7	25	7
13	8		

7. Discuss Taguchi's philosophy for quality improvement. Discuss his loss function and its contribution. (6)

8. The automatic focus unit of a television camera has 10 components in series. Each component has an exponential time-to-failure distribution with a constant failure rate of 0.05 per 4000 h. Determine the system reliability for 2000 h of operation. Also find the mean time to failure. (6)

9. A life test on 15 electronic components is terminated when 4 failures are found with no replacement of failed items. The time to failure for each is exponentially distributed. The failure times (in hours) are 400, 480, 610 and 660 h. Estimate the mean time to failure and the failure rate. Find a 95% confidence interval for the mean time to failure. (6)

10. Distinguish between single level and multilevel sampling plans for continuous production. (6)

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