RollNo. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. /B.Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, NOV/DEC 2023

INDUSTRIAL ENGINEERING

FIFTH SEMESTER

IE5551 ENGINEERING QUALITY CONTROL

(Use of Statistical Tables are Permitted)

(Regulation2019)

Time:3hrs Max.Marks: 100

CO1	Students will become familiar with details of quality costs, economies and planning.
CO2	Control the quality of processes using control charts for variables in manufacturing/service industries. CO3:. CO4:. CO5:.
CO3	Good understanding and in depth knowledge has been imparted in the process capability study
CO4	Control the occurrence of defects in product or services industries
CO5	Determination of acceptance sampling procedures are practiced

BL – Bloom's Taxonomy Levels

(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART- A(10x2=20Marks)

(Answer all Questions)

Q.No	Questions	Marks	CO	BL
1	What are cost of quality?	2	1	L2
2	How will you compare Quality Assurance and Quality Control?	2	1	L3
3	How will you compare Process Variation with Specification Limits?	2	2	L1
4	How will you differentiate the special cause variation and chance cause variation?	2	2	L1
5	Define Gauge Capability Study with an example	2	3	L2
6	When do we use Multi-vari Chart?	2	3	L2
7	When the standard is specified for non conformities in the C chart, how do you compute control limits?	2	4	L1
8	What are Class 1 and Class 3 defects in charts for demerits per unit?	2	4	L1
9	How will you compute the probability of making a decision after the first sample in double sampling plan?	2	5	L3
10	Write note on IS2500 standards	2	5	L4

PART- B(5x 13=65Marks)

(Restrict to a maximum of 2 subdivisions)

Q.No	Questions	Marks	CO	BL
11 (a) (i)	Discuss the economies and dimensions of quality and the relationship of quality vs reliability as well as the Taguchi's QLF three cases with an example	13	01	L3
	OR			
11 (b) (i)	A manufacturer of magnetic tapes is interested in reducing the variability of the thickness of the coating on the tape. It is estimated that the loss to the consumer is \$10 per reel if the thickness exceeds 0.005±0.0004mm. Each reel has 200 m of tape. A random sample of 10 yields the following thickness(inmillimetres):0.0048,0.0053,0.0051,0.0051,0.0052,0.0049,0.0051,0.0047,0.0054,0.0052. Is it cost effective to use the new process? What is the annual savings or loss? Suppose that the manufacturer can rework the thickness prior to shipping the product at a cost of \$2.00 per reel. What should the manufacturer's tolerance be? Suppose the manufacturer has the ability to center the process such that the average thickness of the coating is at 0.005mm, which is the target value. In doing so, the manufacturer estimates that the standard deviation of the process will be 0.018mm. the cost of making this change in the process is estimated to make this change, compared to the original process? What would the annual savings or loss be if the annual production is 10,000 reels?	13	01	L4
12 (a) (i)	A manufacturing shop has decided to use modified control limits for the X-bar chart both for process control and product acceptance. A random sample of five items was drawn from the storage bin and inspected. If the sample mean falls outside the reject limits, the items in the storage bin are screened for defectives. Past analysis indicates that the dimensions follow normal distribution with an estimated σ of 3.6mm. the specification spread/range (U-L) is 50 mm. find the following: (i) Is the process suitable for using reject limits? (ii) Determine reject limits is U=1040 and L=990 mm (iii) If the process is operating at a mean value of 1035 mm, what fraction of defective is produced?	13	02	L4
	OR			

CONTROLLER OF EXAMINATIONS AU CHENNAI 600 025

12 (b) (i)	The baking time of painted corrugated sheet metal is of interest. Too much time will cause the paint to flake, and too little time will result in an unacceptable finish. The specifications on baking time are 10+0.2 min. Random samples of size 6 are selected, and their baking times noted. The sample means and standard deviations are calculated for 20 samples, with the following results: $\sum_{i=1}^{20} X_i = 199.8$ $\quad$ $\sum_{i=1}^{20} S_i = 1.40$ (I)Find the center line and control limits for the X and S charts (II)Estimate the process mean and standard deviation, assuming the process to be in control? (III)If the process capable? What proportion of the output is nonconforming? (iv)If the mean of the process can be shifted to 10 min, would you recommend such a change?	**13**	02	L4
13 (a) (i)	The emergency service unit in a hospital has a goal of 3.5 min for the waiting time of patients before being treated. A random sample of 20 patients is chosen and the sample average waiting time is found to be 2.3 min with a sample standard deviation of 0.5 min. Find an appropriate Process capability index. Comment on the ability of emergency service unit to meet the desirable goal. What are some possible actions to consider?	**13**	03	L2
	OR			
13 (b) (i)	In an injection molding process, the die wears out gradually. To account for this wear, it is suggested that a trend chart be constructed for the outside diameter of the component produced. Samples of size 5 are selected and the sample average $\bar{X}$ and range R are found. Construct the center line and control limits of a trend chart for the sample average. Is the process in control? If the process is out of control, assume special causes, and revise the limits. Suppose that the specification limits are 110 ± 8 mm. At what point should the die be changed? The results of 20 such samples are shown in Table.	**13**	03	L2

CONTROLLER OF EXAMINATIONS AU CHENNAI 600 025

Sample Average and Range Values for Injection Molding Process (in mm)

Sample	*Sample Average, $\bar{X}$*	*Sample Range, R*	*Sample*	*Sample Average, $\bar{X}$*
1	107.6	3.1	11	111.6
2	104.3	2.6	12	113.3
3	103.5	2.8	13	109.8
4	105.7	2.4	14	110.3
5	104.8	3.2	15	108.6
6	108.5	2.5	16	112.7
7	109.7	2.8	17	114.2
8	105.3	1.7	18	115.5
9	112.6	2.4	19	112.8
10	110.5	2.0	20	116.2

14 (a) (i) Twenty random samples are selected from a process that makes vinyl tiles. The sample size as well as the number of nonconforming tiles are shown in table 2 construct a standardized P-chart and give your inferences. **13** 04 L5

Table 2: Vinyl Tile Data

Sample	Number of Inspected Tiles n_i	Number of Non conforming Tiles	Sample	Number of Inspected Tiles n_i	Number of Non conforming Tiles
1	200	6	11	190	5
2	180	8	12	380	4
3	200	5	13	200	12
4	120	4	14	210	8
5	300	10	15	390	12
6	250	11	16	120	6
7	400	3	17	190	4
8	180	5	18	380	7
9	210	10	19	200	14
10	380	10	20	180	4

OR

ADDITIONAL CONTROLLER OF EXAMINATIONS AU CHENNAI 600 025

14 (b) (i)	A C-chart is used to monitor surface defects on a painted surface. they use 3 sigma control limits and 2 sigma warning control limits to monitor the defects. If a point falls above the control limit or two points in a row fall between warning and control limits, the process is stopped, the central limit is set at an aimed value of Co=2.5.Compute control and warning limits If the process suddenly shifts to a men value of 5, what is the probability that a point will fall above the control limits? Under conditions of the above, what is the probability that two points fall in a row between the warning and control limits? what is the combined probability of detection of this shift within the first two units inspected after the shift?	**13**	04	L5
15 (a) (i)	Design a single sampling plan from the following parameters: AQL=0.02, LTPD=0.08, α=0.05 and β=0.10	**7**	05	L3
(ii)	For the double sampling plan N=3000,n1=40,c1=1,r1=4,n2=80,c2=3,r2=4, find the ASN for batches with a proportion non conforming of 0.02, assuming no curtailment	**6**	05	L1
	OR			
15 (b) (i)	Let's consider a double sampling plan of lot size 3000 given by the following parameters: n1=40, c1=1, r1=5, n2=80, c2=5, r2=6. For a lot proportion nonconforming value of p=0.03, find the probability of accepting such lots	**8**	05	L3
(ii)	Find a Sequential sample plan for which P1=0.01, α=0.05, P2=0.06, β=0.10?	**5**	05	L2

PART- C(1x 15=15Marks)

(Q.No.16 is compulsory)

Q.No	Questions	Marks	CO	BL
16. (i)	Three components x_1, x_2 and x_3 are normally independently distributed with mean μ_1=2 and μ_2=1 and μ_3=3, respectively. The assembly specification is fixed at 6.00±0.06. Determine the component tolerances so that C_p=1.50 for the assembly	**5**	03	L6
(ii)	Show the Assembly tolerance is fixed by functional requirements determining overlapping tolerances for the components and Component tolerances are fixed, determine assembly specification	**10**	03	L6

ADDITIONAL CONTROLLER OF EXAMINATIONS
AU
CHENNAI
600 025