14MEE657 USN

Sixth Semester B.E. Degree Examination, April / May 2017
Mechanical Engineering
Statistical Quality Control (14MEE657)

Max. Marks:100

Instructions: 1. Answer one full question from each unit.
2. Any missing Data can be suitably assumed.

UNIT-I

			CO; BL
1.	a.	Define SQC. Illustrate with an example.	04 Marks 1;1
	b.	Explain the various statistical methods for quality control and improvement.	06 Marks 1;2
	c.	"Cost plays vital role in a manufacturing firm". Briefly explain the various category of quality costs.	10 Marks 1;2
2.	a.	Enumerate the link between quality and productivity.	06 Marks 1;2
	b.	Define TQM? Explain the philosophy of TQM.	10 Marks 1;1
	c.	Define the term quality and list the objectives of quality control.	04 Marks 2;1

UNIT-II

3.	a.	Differentiate between variable data and attribute data.	04 Marks 2;2
	b.	Determine mean, median, mode and standard deviation for the following data	10 Marks 2;3

Marks	0-10	10-20	20-30	30-40	40-50	50-60
No. of students	12	18	27	20	17	6

	c.	Briefly explain the various causes of variation in quality.	06 Marks 2;2
4.	a.	The time taken to complete a particular job is normally distributed with a mean of 40 minutes and a standard deviation of 8 minutes. A total of 25 jobs are to be performed.	08 Marks 3;3
		i) How many jobs are expected to take more than 48 min	
		ii) How many jobs are expected to be completed within 35 min	
		iii) Expected total no. of jobs that can be completed between 20 to 50 min	
	b.	Explain the following	
		i) Warning limits	06 Marks 2;2
		ii) Specification limit	
		iii) Average run length	
	c.	Define control chart? Enlist the significance of control chart.	06 Marks 2;1

UNIT-III

5.	a.	Define Type–I and Type-II errors in control charts.	05 Marks 2;1
	b.	The following are the $\overline{X}$-R chart values of 20 subgroupd of 5 samples readings with a specification limit of 33±5.	15 Marks 2;3

S.G. No.	$\overline{X}$	R	S.G. No.	$\overline{X}$	R
1	34	4	11	38.4	4
2	31.6	2	12	34	14
3	30.8	3	13	35	4
4	33.8	5	14	33.8	7
5	31.6	2	15	31.6	5
6	33	5	16	33	7
7	28.2	13	17	32.6	3
8	33.8	19	18	31.8	9
9	37.8	6	19	35.6	6
10	35.8	4	20	33	4

i) Determine the control limits for $\overline{X}$-R chart
ii) Construct the $\overline{X}$-R chart and interpret the result
iii) What is process capability
iv) Does it appear that the process is capable of meeting the specification limit
v) Determine the % of rejection, if any

6. a. Explain the terms
   i) Process capability
   ii) Process capability index (CPK)
   iii) Process performance index (PPK)

   06 Marks 3;2

   b. Subgroups of 4 items each are taken from a manufacturing process at regular intervals. A certain quality characteristics is measured $\overline{X}$, R values are computed for each subgroup. After 25 subgroup $\Sigma\overline{X}$ =15350, ΣR=411.4
   - Compute the control limits for $\overline{X}$-R chart
   - Assume all the points are falling with in control limits on both the charts. The specification limits are 610±15. If the quality characteristics is normal distributed. What % of product would fail to meet the specification?
   - Any product that falls below LSL will be scrapped and falls above USL must be reworked, it is suggested that the process can be centered at a level, so that not more than 0.1% of the product will be scrapped. What should be the aimed value of $\overline{X}$ to make the scrap exactly 0.1%
   - What % of rework can be expected with this centering

   14 Marks 2;3

UNIT-IV

7. a. Briefly explain the attribute control chart.

   08 Marks 3;2

   b. A product is produced which undergoes a 100% inspection as it is manufactured. The samples are summarized as follows

Sample No.	1	2	3	4	5	6	7	8	9	10
No of items inspected (n)	48	36	50	47	48	54	50	42	32	40
No. of defective (d)	5	5	0	5	0	3	0	1	5	2

   - Construct a suitable control chart and offer your comments
   - What value of center line would you recommend for the future period

   12 Marks 3;3

8. a. Differentiate between attribute control chart and variable control chart.

   04 Marks 4;2

   b. A control chart for defects/unit (U) uses the probability limits corresponding to the probabilities of 0.95 and 0.05. at $\overline{U}$ =1.5 the limits vary with the value of n. Determine the correct position of UCL and LCL when n=6.

   04 Marks 3;3

   c. The following are the inspection results of 100mtrs of a piece of woolen cloth
   - Determine the control limits for C-chart
   - Plot the data and offer your comments
   - What value of $\overline{C}$ would you suggest for use future period

   12 Marks 4;2

UNIT-V

9. a. Draw a flow chart for a double sampling plan.

   05 Marks 4;1

   b. The lot size is 2000 in a certain AOQL inspection procedure. The desired AOQL of 1% can be obtained with any one of the sampling plans.

Plan I	Plan II	Plan III
n=36	n=80	n=140
C=0	C=1	C=2

   Which plan will you select considering both sampling inspection and screening of rejected lot if a large no., of lots of 0.5% defective are submitted?

   10 Marks 4;3

   c. Write a note on V-mask procedure used in CUSUM chart.

   05 Marks 4;1

10. a. Design a sequential sampling plan for the following specifications α=0.05, P_1=0.10, β=0.2, P_2=0.3. Compute
   - Average outgoing quality when P'=P_1
   - Min no., of items inspected for accepting the lot
   - Min no., of defectives for rejection of the lot
   - Average no., of items inspected when the quality of the lot is P_1

   12 Marks 5;3

   b. What is EWMA control chart? Explain.

   08 Marks 5;1

14ME0765 USN

Supplementary Semester BE Examination, July/Aug-2018
Mechanical Engineering
Statistical Quality Control (14ME0765)

Max. Marks:100

Instructions: 1. Answer one full question from each unit.
2. Any missing Data can be suitably assumed.

UNIT-I

			Marks	CO/PO; BL
1.	a.	Define the term quality ? Enlist the various quality dimensions.	05Marks	
	b.	List & explain the various methods for quality control & improvements.	10Marks	
	c.	List the tools of SQC? Enumerate any one	05Marks	
2.	a.	Enumerate the term SQC with example	06 Marks	
	b.	Define cost of quality ? Explain the various types in it.	08Marks	
	c.	Explain Deming's PDCA cycle.	06Marks	

UNIT-II

3.	a.	Brifely explain the various measures of central tendency & dispersion.	10 Marks	
	b.	Define the following terms i)Warming limits. ii)Avg. Run length (ARL)	04 Marks	
	c.	Assuming that the life in hrs of an electric bulb is a random variable following normal distribution with mean of 2000hrs & Std., deviation of 400hrs.Find the expected number of bulbs having life. i)More than 3000hrs ii)Between 2600-2800hrs.	06Marks	
4.	a.	Differentiate between chance & assignable causes.	05 Marks	
	b.	For the following data, calculate the mean & standard deviation.	06 Marks	

Cell mid point	Cell boundaries	Frequency
385	382.5	8
390	387.5	10
395	392.5	15
400	402.5	8
405	407.5	8

	c.	Define state of lack of control? Briefly Explain the reasons for lack of control	09 Marks	

UNIT-III

5.	a.	Briefly Explain type-I and Type-II errors.	04 Marks	
	b.	In a capability study of a lathe used in turning a shaft to a diameter of 23.75±0.1mm a sample of 6 consecutive pieces was taken each days for 8 days. The diameter of these shafts are as given below.,	10 Marks	

X	23.765	23.77	23.77116	23.7767	23.7717	23.7583
R	0.07	0.11	0.06	0.08	0.04	0.05

X	23.7767	23.7667
R	0.06	0.07

	c.	Why does a capable manufacturing process giving defects? Illustrate with reasons	06Marks	
6.	a.	Define the following? i)C_p ii) C_{pk} iii) PP_k	06 Marks	
	b.	Subgroup of 5 items each are taken from a manufacturing process at regular intervals. A certain quality characteristics is measures & X , R values computes for each subgroup. After 25 subgroups $\Sigma X = 357.5$, $\Sigma R = 8.8$. Assume that all points are within the control limits on both the charts. The specifications are 14.4±0.4. i)Compute the control limits for X & R charts.	14 Marks	

ii)What is process capability.
iii)Determine the % of rejections if any
iv)What can you conclude regarding its ability to meet the specifications.

UNIT-IV

7. a. Briefly explain the various control charts for attributes. 08 Marks

b. A manufacturer use a injection moulding to produce a plastic insulation barrier, the inspects 100 barriers daily picked randomly from the production & determine the numbers of defect by visul inspection . He wishes the data accumulated during a 10 days period to construct an attribute chart. 12 Marks

The results of inspection are shown below.,

LOT No	1	2	3	4	5	6	7	8	9	10
No. of items rejected	6	14	18	10	2	20	18	5	12	8

8. a. The following are he inspection results of 100mtrs of a piece of woolen cloth

Piece no.	1	2	3	4	5	6	7	8	9	10
No. of defects	3	3	6	3	0	1	3	5	7	8

12 Marks

i)Determine the control limits for C-Chart.
ii)Plot the data & offer your comments.
iii) What value of C' would you recommend for future period.

b. Difference between. 08Marks
   i) P-charts& np chart
   ii) C –chart & U chart.

UNIT-V

9. a. Differentiate between type A curve & Type B curves. 04 Marks

b. A double sampling p[lan is as follows: 12 Marks
$N=5000\ n_1=150\ ,n_2=200,C_1=3\ C_2=8$
Calculate P_a, ATI, AOQ, ASN.

C. Write a note on sequential sampling plan 04Marks

10. a. Give the flow chart for the double sampling plan 05Marks

b. A single sampling plan is as follows., 10 Marks
$N=4000\ n=75\ C=2$
   i) Plot the OC curve
   ii) Find the producer risk if AQL is 1.5% & LTPD if the consumer risk is 10%
   iii) Find the ATI of the above plan at 1.5% defective of the incoming lot.

c. Write a note on EWMA control charts. 05Marks

14MEO765 USN

Seventh Semester B.E. Degree Examination, December 2017
Mechanical Engineering
Statistical Quality Control (14MEO765)

Instructions: 1. Answer one full question from each unit. **Max. Marks:100**
2. Any missing Data can be suitably assumed.

UNIT-I

			Marks	CO; BL
1.	a.	Explain Quality of conformance and Quality of performance.	07 Marks	1;1
	b.	What is meant by Quality Improvement? List out the methodology adopted for quality improvement over a period of time.	07 Marks	1;2
	c.	Explain briefly links between quality and productivity.	06 Marks	1;1
2.	a.	Explain significance of legal aspects of quality.	08 Marks	1;1
	b.	Summarize the contribution of the following persons to quality management i) Deming ii) Juran iii) crosby	12 Marks	1;1

UNIT-II

3.	a.	What are the different methods of measure of central tendency and measure of dispersion?	10 Marks	2;1
	b.	The mean and standard deviation of a sample of 100 observations was calculated as 40 and 5.1 respectively. While comparing with the original data it was found that by mistake a figure of 40 was miscopied as 50 for one observation, calculate the correct mean and standard deviation of the sample.	10 Marks	2;3
4.	a.	Explain briefly Deming's funnel experiment.	08 Marks	1;1
	b.	Assuming that the life in hours of an electric bulb is a random variable following normal distribution with mean of 2000 hours and standard derivation of 400 hours. Find the expected number of bulbs from a random sample of 2000 bulbs having life a) more than 3000 hours b) between 2600 and 2800hrs	08 Marks	2;3
	c.	Analyze the different patterns of variation.	04 Marks	3;4

UNIT-III

5.	a.	Differentiate between the chance cause and assignable causes of variation.	04 Marks	2;3
	b.	What is meant by process capability? How will you determine the same?	04 Marks	3;2
	c.	Control charts for $\overline{X}$ and R are maintained on certain dimensions of a manufactured part, measured in mm. The subgroup size is 4. The values $\overline{X}$ and R are computed for each subgroup. After 20 subgroups $\sum\overline{X}$ =412.83 and $\sum$R=3.39 Compute the values of 3 sigma limits for the $\overline{X}$ and R charts and estimate the value of σ' on the assumption that the process is in statistical control.	12 Marks	3;4
6.	a.	Discuss the implication of control limit location in terms of Type I and Type II error.	04 Marks	3;2
	b.	Discuss three primary applications of control charts.	04 Marks	2;1
	c.	In a capability study of a lathe. Used in turning a shaft to a diameter of 23.75±0.1mm a sample of 6 consecutive pieces was taken each day for 8 days. Construct the $\overline{X}$ and R chart and find out the process capability for the machine.	12 Marks	3;3

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1st day	2nd day	3rd day	4th day	5th day	6th day	7th day	8th day
23.77	23.80	23.77	23.79	23.75	23.78	23.76	23.76
23.80	23.78	23.78	23.76	23.78	23.76	23.76	23.79
23.78	23.76	23.77	23.79	23.78	23.73	23.78	23.77
23.73	23.70	23.77	23.74	23.77	23.76	23.75	23.72
23.76	23.81	23.80	23.82	23.76	23.74	23.76	23.78
23.75	23.77	23.74	23.76	23.79	23.78	23.81	23.78

UNIT-IV

7. a. Explain the difference between c-chart and u-chart. 06 Marks 4;2
   b. Distinguish between attribute chart and variable chart. 06 Marks 4;2
   c. 50 motors were inspected per day best estimates of the universe fraction defective is 0.076. Determine the control limits. On a particular day 5 defective motors were discovered. Is the forces process in control or out of control? 08 Marks 4;4

8. a. What is the purpose of P chart compare it with $\overline{X}$ and R chart. 08 Marks 4;2
   b. In a manufacturing process, the number of defectives found in the inspection of 15 lots of 400 items each are given below.

Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Number of defective	2	5	0	14	3	0	1	0	18	8	6	0	3	0	6

   a) Determine the trial control limits for np chart and state whether the process and is in control.
   b) What will be new value of fraction defective if outside control limits are eliminated. Find out new upper and lower control limit. 12 Marks 4;3

UNIT-V

9. a. Discuss different sampling plans. 08 Marks 5;1
   b. A double sampling plan, N=5000, n_1=100, C_1=0, n_2=100 and C_2=1.
   a) Use Poisson's table to compute the probability of acceptance of a 1% defective lot
   b) Assume that a lot rejected by this sampling plan will be 100% inspected. What will be the AOQ if the submitted product is 1% defective? Considering both the inspection of rejected lots, what will be the average number of articles inspected per lot of the submitted product is 1% defective. 12 Marks 5;3

10. a. What are the different Quality indices for acceptance sampling plan. 06 Marks 5;2
    b. Distinguish between producer's risk and consumer's risk. 04 Marks 5;3
    c. Design a cerscem chart and V-mask. 06 Marks 5;2
    d. What is the significance of EWMA chart? 04 Marks 5;2

4MEE657 USN

Sixth Semester B.E. Degree Examination, April / May 2018
Mechanical Engineering
Statistical Quality Control (14MEE657)

Max. Marks:100

Instructions: 1. Answer one full question from each unit.
2. Any missing Data can be suitably assumed.

UNIT-I

		Marks	CO; BL
a.	Evaluate and analyze the statement "higher quality of design means higher costs, quite often it also means higher values".	10 Marks	1:2
b.	Enlist the various benefits of SQC.	05 Marks	1:2
c.	Explain the following as applied to quality control. i. Appraisal cost. ii. Prevention cost. iii. Failure cost. iv. Optimum cost.	05 Marks	1:2
a.	Explain the contribution made by the following pioneers in quality control. i. Deming. ii. Juran. iii. Crosby.	10 Marks	1:2
b.	Distinguish between quality of design and quality of conformance with suitable example.	10 Marks	1:2

UNIT-II

3. a. A machine shop produces steel pin. The width of 100 pins was checked and recorded.

Width in mm	Frequency
9.5-9.51	6
9.52-9.53	2
9.54-9.55	20
9.56-9.57	32
9.58-9.59	22
9.60-9.61	8
9.62-9.63	6
9.64-9.65	4

10 Marks 2:3

i. Find the arithmetic mean, standard deviation; variance.
ii. What percentage of the pins manufactured has width of 9.52 to 9.63.

b. Assume that the life of an electric bulb on hours is a random variable following normal distribution with a mean of 2000 hours and standard deviation of 400 hours. Find the expected number of bulbs from a random sample of 2000 bulbs having a life of, 10 Marks 2:3
i. More than 3000 hours.
ii. Between 2600 and 2800 hours.

4. a. Distinguish between chance cause and assignable causes of variation giving suitable examples. 06 Marks 3:1
b. What is process capability? How it decides the remedy that should be take to bring the process in control? 08 Marks 3:2
c. Compare the three measures of central tendency. 06 Marks 3:1

UNIT-III

5. a. The following data are obtained while manufacturing a product for the subgroup size is 5

Sample No.	X	R	Sample No.	X	R
1	177.6	23	11	179.8	9
2	176.6	8	12	176.4	8
3	178.4	22	13	178.4	7
4	176.6	12	14	178.2	4
5	177	7	15	180.6	6
6	179.4	8	16	179.6	6
7	178.6	15	17	177.8	10
8	179.6	6	18	181.6	9
9	178.8	7	19	177.6	7
10	178.2	12	20	178.4	10

12 Marks

Determine the trial control limits for $\bar{X}$ chart and R chart. Give conclusion. The specified requirements for the quality characteristics 171±11. If a product falls below lower specification limit it must be scrapped. Where as if it falls above 182 it may be reworked. What would you suggest as the aimed value for process centering why? Recommend new limits on $\bar{X}$ chart and R chart.

b. Discuss the different pattern of variation. 08 Marks

6. a. Analyze the assignable causes for variation in the turning operation. Suggest probable reasons for these causes. 10 Marks

b. Construct $\bar{X}$ and R charts and determine the process capability of the lathe for the following data. In a capability study of a lathe used in turning a shaft to a diameter of 23.75±0.1 mm a sample of 6 consecutive pieces was taken each day for 8 days. The diameter of these shafts are given below.

1st day	2nd day	3rd day	4th day	5th day	6th day	7th day	8th day
23.77	23.8	23.77	23.79	23.75	23.78	23.76	23.76
23.80	23.78	23.78	23.76	23.78	23.76	23.78	23.79
23.78	23.76	23.77	23.79	23.77	23.73	23.75	23.77
23.73	23.70	23.77	23.74	23.76	23.76	23.76	23.72
23.76	23.81	23.80	23.82	23.78	23.74	23.81	23.78
23.75	23.77	23.74	23.76	23.79	23.78	23.80	23.78

10 Marks

UNIT-IV

7. a. Define the purpose of P chart and np chart.

b. An analyst takes 20 samples of size 200 each from the output of a final assembly line. The results given in the table below. Calculate the average fraction defective and the control limits for fraction defective. 05 Marks

Sample No	No of defective	Sample No	No of defective
1	9	11	26
2	7	12	18
3	14	13	11
4	15	14	8
5	8	15	10
6	7	16	10
7	9	17	15
8	11	18	13
9	16	19	9
10	12	20	12

10 Marks 4:3

c. Distinguish between defect and defective. 05 Marks 4:1

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a. Distinguish between variable chart and attribute chart. 05 Marks 4:1

b. In a manufacturing process the number of defectives found in the inspection of 15 lots of 400 items each are given below. 07 Marks 4:3

Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
No. of defectives	2	5	0	14	3	0	1	0	18	8	6	0	3	0	6

Find out the control limits for np chart. Find out optimum value of fraction defective and control limits.

c. The following table gives the number of missing rivets during an aircraft inspection. 08 Marks 5:3

Lot No.	No. of defective	Lot No.	No. of defective
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		

Find C compute trial control limits and plot control chart. What values of C would you suggest to subsequent period.

UNIT-V

a. With a neat diagram of OC curve define, 10 Marks 5:1
   i. Producer risk.
   ii. Consumer risk.
   iii. AQL.
   iv. LTPD.

b. A single sampling plan is as follows N = 10000, n=100 & C = 2
   i. Compute the appropriate probability of acceptance of lots with 1% defective. 10 Marks 5:3
   ii. Determine the AOQ value for the above lots.

a. The lot size N is 2000 in a certain AOQL inspection procedure. The desired AOQL of 2% can be obtained with any of the 3 sampling plane
   i. n = 65, C = 2.
   ii. n = 41, C = 1. 10 Marks 5:3
   iii. n = 18, C = 0.
   iv. If lots of 0.3% defective are submitted for acceptance. What will be the average no. of units inspected per lot under each of these sampling plans?

b. Explain the double sampling plan for acceptance with help of flow diagram. 10 Marks 5:2