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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Seventh Semester, B.E. - Automobile Engineering

Semester End Examination; Dec - 2016/Jan - 2017

Statistical Quality Control

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Use of SQC table is permitted.

UNIT - I

1 a. Define quality. What are the objectives of quality control? 8

b. Explain the various components, which contribute to quality costs. 6

c. What is the meaning of quality of conformance? Explain the factors influencing quality of conformance. 6

2 a. What are the benefits of statistical quality control? 6

b. What is the meaning of quality of design? Explain the factors influencing quality of design. 8

c. Explain briefly the meaning of quality management. 6

UNIT - II

3. The following table shows the diameters in mm of a sample of 50 ball bearings manufactured by a certain process. 20

18.75	18.49	18.92	18.62	18.67	18.82	18.62	18.75	18.64	18.59
18.52	18.72	18.69	18.54	18.59	18.67	18.85	18.42	18.75	18.69
18.87	18.69	18.85	18.59	18.67	18.57	18.69	18.62	18.77	18.82
18.80	18.67	18.80	18.54	18.47	18.44	18.77	18.64	18.47	18.69
18.69	18.39	18.49	18.77	18.64	18.72	18.67	18.59	18.67	18.90

i) Construct a frequency distribution of the diameters using intervals of 0.12 mm

ii) Construct a histogram

iii) Determine the mean and standard deviation

iv) Would you expect the process to be capable of producing the ball bearings to the following specification? 18.66±0.50 mm.

4 a. What is the importance of normal distribution in quality control? State some of the characteristics of normal distribution. 6

b. A random sample of 5 items is drawn from a lot of 30 items, 3 of which are defectives. Determine the probability that the sample will contain, i) exactly 2 defectives, ii) less than 3 defectives, iii) more than 2 defectives, using the exact method. 8

Contd.....2

c. A controlled manufacturing process is 0.3% defective. What is the probability of taking 2 or more defectives from a lot of 100 pieces? 6

i) By using Binomial distribution

ii) By Poisson approximation.

UNIT - III

5 a. State the objectives of $\bar{x}$ and R charts. 4

b. The following are the mean and range of 20 samples of 6 pins each (in mm). Use the first 10 samples to set up control charts for mean and ranges to control future production. Plot the next 10 samples, what proportion of production may be expected to lie outside the tolerance limits 10.88 ± 0.12 mm assuming the pins to be normally distributed? 16

Sample	Mean	Range	Sample	Mean	Range
1	10.93	0.25	11	10.93	0.15
2	10.81	0.23	12	10.81	0.10
3	10.80	0.20	13	10.89	0.25
4	10.86	0.10	14	10.81	0.13
5	10.87	0.13	15	10.77	0.20
6	10.83	0.28	16	10.88	0.28
7	10.85	0.23	17	10.83	0.15
8	10.86	0.08	18	10.87	0.13
9	10.77	0.05	19	10.90	0.10
10	10.88	0.15	20	10.94	0.15

6 a. Define process capability. Explain the various course of action often employed under the following situations : 10

i) Process capability is greater than the specified tolerance

ii) Process capability is approximately equal to the specified tolerance

iii) Process capability is less than the specified tolerance.

b. A sub group of 5 items each are taken from a manufacturing process at regular intervals. A certain quality characteristic is measured and $\bar{x}$ and R values are computed. After 25 sub groups, it is found that $\sum \bar{x} = 357.50$ and $\sum R = 8.80$. If the specification limits are 14.40 ± 0.40 and if the process is in statistical control, what conclusions can you draw about the ability of the process to produce items within specification? Determine the natural tolerance of the process. For sub group of 5 items, $d_2 = 2.326$. 10

Contd.....3

UNIT - IV

7 a. What are type I and type II errors? Distinguish clearly between *p* and *np* charts. 6

b. The following are the inspection results of castings.

Day No.	1	2	3	4	5	6	7	8	9	10
No. of castings produced	154	152	148	150	154	145	151	154	150	153
No. of defective castings	4	2	2	4	3	4	2	2	1	4

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Calculate the average fraction defective and 3 sigma control limits. Construct the control chart for fraction defectives. State whether the process is in statistical control or not. If not revise the control limits.

8 a. Distinguish between a defect and defective. Explain the classification of defects. 8

b. The number of defects on 20 items are given below :

Item Number	1	2	3	4	5	6	7	8	9	10
Number of defects	2	0	4	1	0	8	0	1	2	0
Item Number	11	12	13	14	15	16	17	18	19	20
Number of defects	6	0	2	1	0	3	2	1	0	2

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Devise a suitable control scheme for the future.

UNIT - V

9 a. What is acceptance sampling? What are its advantages? 6

b. A single sampling plan is as follows: $N = 10000$, $n = 120$, $c = 3$. Determine;

i) The probability of acceptance of 2% defective lot

ii) AOQ and ATI. 14

Also draw an OC curve, taking at least 6 points.

10 a. What do you mean by producer's risk and consumer's risk? 4

b. A double sampling plan is as follows: $N = 1000$, $n_1 = 36$, $c_1 = 0$, $n_2 = 59$, $c_2 = 3$,

i) What is the probability of acceptance for a lot of 1% defective?

ii) What is AOQ of the plan? 16

iii) What are ASN and ATI?

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