**U.S.N** ☐☐☐☐☐☐☐☐☐☐

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

*(An Autonomous Institution affiliated to VTU, Belgaum)*

### Sixth Semester, B.E. - Mechanical Engineering
### Semester End Examination; June/July - 2015
### Statistical Quality Control

*Time: 3 hrs*　　　　　　　　　　　　　　　　　　　　　　*Max. Marks: 100*

*Note:* i) *Answer any **FIVE** full questions, selecting at least **TWO** full questions from **each part.***
　　　ii) *Use of distribution and control chart is permitted.*

## PART - A

| | | |
|---|---|---|
| 1 a. | Discuss the sequence of activities for any quality characteristic. | 6 |
| b. | Explain the factors that measures the performance of a quality product. | 8 |
| c. | List the major objectives of quality control. | 6 |

2 a. Compute the average and the standard deviation of the following distribution which shows the result of distribution of the resistance of 500 units of certain electrical product:　　　**12**

| Resistance Ω | 2.7-2.9 | 3.0-3.2 | 3.3-3.5 | 3.6-3.8 | 3.9-4.1 | 4.2-4.4 | 4.5-4.7 | 4.8-5.0 | 5.1-5.3 |
|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2 | 16 | 46 | 88 | 138 | 113 | 71 | 22 | 4 |

　　b. The mean and standard deviation of a sample of 100 observations was calculated as 40 and 5.1 respectively. While computing 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.　　**8**

3 a. Discuss the continuous and discontinuous probability distribution.　　**4**

　　b. A stipulated acceptance procedure calls for examining 8 articles from a lot of 1000 articles. If none of the 8 articles are defective, the lot is accepted otherwise it is rejected. Assume that the lot containing 10% defective articles is submitted for acceptance:

　　i) Using hyper geometric probabilities, compute the probability of acceptance.

　　ii) Using the bionomial distribution as an approximation, compute the approximate probability of acceptance.　　**16**

　　iii) Using the normal distribution as an approximation to the bionomial, compute the approximate probability of acceptance.

4 a. What are the different types of assignable cause patterns of variations? Explain.　　**6**

b. The following table shows the averages and ranges of the spindle diameters in mm for 30 subgroups of 5 items each.

| $\overline{X}$ | R | $\overline{X}$ | R | $\overline{X}$ | R | $\overline{X}$ | R |
|---|---|---|---|---|---|---|---|
| 45.020 | 0.375 | 45.660 | 0.475 | 45.800 | 0.475 | 45.380 | 0.125 |
| 44.950 | 0.450 | 45.680 | 0.275 | 45.500 | 0.200 | 45.660 | 0.350 |
| 45.480 | 0.450 | 45.600 | 0.275 | 45.780 | 0.275 | 45.460 | 0.225 |
| 45.320 | 0.150 | 45.020 | 0.175 | 45.640 | 0.225 | 45.640 | 0.375 |
| 45.280 | 0.200 | 45.320 | 0.200 | 45.26 | 0.150 | 45.390 | 0.650 |
| 45.820 | 0.250 | 45.560 | 0.425 | 45.650 | 0.200 | 45.290 | 0.350 |
| 45.580 | 0.275 | 45.140 | 0.250 | 45.620 | 0.400 | | |
| 45.400 | 0.475 | 45.620 | 0.375 | 45.480 | 0.225 | | |

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For the first 20 samples setup an $\overline{X}$ and R chart. Plot the next 10 samples on these charts to see if the process continuous under control both as to average and range. Also find the process capability.

## PART - B

5 a. How do the process capability information used in serving multiple purposes?    7

b. What do you mean by capability ratio? How it is related to product tolerance?    5

c. With the help of an example explain capability index. What are the types of process capability study?    8

6 a. In a factory producing spark plug the number of defectives found in inspection of 20 lots of 100 each, is given below:

| Lot No. | No. of defectives | Lot No. | No. of defectives | Lot No. | No. of defectives | Lot No. | No. of defectives |
|---|---|---|---|---|---|---|---|
| 1 | 5 | 6 | 4 | 11 | 4 | 16 | 4 |
| 2 | 10 | 7 | 6 | 12 | 7 | 17 | 5 |
| 3 | 12 | 8 | 3 | 13 | 8 | 18 | 8 |
| 4 | 8 | 9 | 3 | 14 | 3 | 19 | 6 |
| 5 | 6 | 10 | 5 | 15 | 3 | 20 | 10 |

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i) Construct appropriate control chart and state whether the process is in statistical control.

ii) Determine the sample size when a quality limit not worse than 90% is desirable and 10% bad product will not be permitted more than three times in thousand.

b. Distinguish between P – chart & C – chart.    6

7 a. Define the following terms and indicate in the OC curve.

    i) Producer's risk   ii) Consumer's risk   iii) AQL   iv) LTPD

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  b. The lot size N is 2000 in a certain AOQL inspection procedure. The desired AOQL of 2% can be obtained with any one of the three sampling plans. These are :

    (i) n = 65, c = 2,   ii) n = 41,   c = 1  and   iii) n = 18, c = 0.

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    If a large number of lots 0.3% defective are submitted for acceptance, what will be the average no. of units inspected per lot under each of these sampling plans?

8 a. With the help of a diagram, explain failure rate curve.

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  b. In one life testing plan 63 items tested for 500 hrs with replacement and with an acceptance number of 5. This plan was stipulated for an appropriate value of 0.10 for the producer's risk of rejection of a lot having a mean life of 10,000 hrs and for a approximate value of 0.10 for the consumer's risk for acceptance of a lot having a mean life of 3333 hours. Compute the respective values of these two risks.

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  c. An element has a probability of successful operation over a given period of 60 percent. If four such elements are connected in parallel estimate the improvement factor.

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