Seat No: _____ Enrollment No: _____

# PARUL UNIVERSITY

## FACULTY OF ENGINEERING & TECHNOLOGY

### M.Tech. Summer 2018 – 19 Examination

**Semester: 2** **Date: 10/05/2019**
**Subject Code: 203208181** **Time: 10:30am to 1:00pm**
**Subject Name: Statistical Process Control** **Total Marks: 60**

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**Instructions:**
1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

**Q.1** A) Multiple Choice Questions. ( Each one mark)

1) The quantity sigma (σ) indicates
a) Trend in the process b) Dispersion in the data
c) Lack of attention by workers d) Average

2) The probability of finding a given number of defectives from a batch follows
a) Normal distribution b) Binomial distribution
c) Poisson distribution d) Exponential distribution

3) Which of the following statements is correct?
a) Under three sigma, the parts per million defective is 0.002 when the process is centered and normally distributed.
b) Under six sigma, the parts per million defective is 0.002 when the process is centered and normally distributed.
c) Under six sigma, the parts per million defective is 3.4 when the process is centered and normally distributed.
d) None of the above

**(05)**

4) In Poisson distribution,
a) The mean is equal to the standard deviation.
b) The mean is equal to the square root of standard deviation.
c) The mean is equal to the variance.
d) The mean is equal to the square of the variance.

5) When using a statistical control chart (SPC), a point outside the control limits is attributed to
a) common or random causes. b) assignable or special causes
c) a problem caused by the system. d) a and c

B) Define acceptance sampling. What are the various advantages and disadvantages of sampling? **(05)**

C) Explain the 'Ishikawa' tool used in SPC along with its application, advantages and limitations. **(05)**

**Q.2 Answer the following questions**. (Attempt any three) (Each five mark) **(15)**

A) Differentiate between variable control charts and attribute control charts.

B) Distinguish between the use of the mean, median, and mode in quality control applications. When do you prefer to use the trimmed mean?

C) Compute the Cpk measure of process capability for the following machine and interpret the findings. What value would you have obtained with the Cp measure? Show specification spread and process spread on normal curve.
Machine Data: USL = 110, LSL = 50, Process σ = 10, Process μ = 60.

D) Explain the difference in interpretation between an observation falling below the lower control limit on an X-chart and one falling below the lower control limit on an R-chart. Discuss the impact of each on the revision of control charts in the context of response time to fire alarms.

**Q.3** A) Samples of fabric from a textile mill, each 100 $m^2$ , are selected, and the number of occurrences of foreign matter are recorded. Data for 25 samples are shown in Table. Construct a c-chart for the number of nonconformities.

| Sample | Nonconformities | Sample | 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 | 24. | 5 |
| 12. | 7 | 25. | 7 |
| 13. | 8 | | |

**(07)**

B) Write the short note on Magnificent Seven. **(08)**

**OR**

B) A control chart is to be constructed for the average breaking strength of nylon fibers. Samples of size 5 are randomly chosen from the process. The process mean and standard deviation are estimated to be 120 kg and 8 kg, respectively.
(a) If the control limits are placed 3 standard deviations from the process mean, what is the probability of a type I error? **(08)**
(b) If the process means shifts to 125 kg, what is the probability of concluding that the process is in control and hence making a type II error on the first sample plotted after the shift? Explain with suitable diagram.

**Q.4** A) The length of a machined part is known to have a normal distribution with a mean of 100 mm and a standard deviation of 2 mm.
(a) What proportion of the parts will be above 103.3 mm?
(b) What proportion of the output will be between 98.5 and 102.0 mm?
(c) What proportion of the parts will be shorter than 96.5 mm? **(07)**
(d) It is important that not many of the parts exceed the desired length. If a manager stipulates that no more than 5% of the parts should be oversized, what specification limit should be recommended? Explain with suitable diagram

**OR**

A) A process is in statistical control with X double bar = 199 and R bar =3.5. The control chart uses a sample size of n = 4. Specifications are at 200 ± 8. The quality characteristic is normally distributed. (for sample size of 4, d2 = 2.059)
(a) Estimate the potential capability of the process.
(b) Estimate the actual process capability. **(07)**

B) Find a single sampling plan that satisfies a producer's risk of 5% for lots that are 1.8%non-conforming, and a consumer's risk of 10% for lots that are 9% nonconforming. **(08)**