



**LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034**

**M.Sc. DEGREE EXAMINATION – STATISTICS**

**THIRD SEMESTER – NOVEMBER 2014**

**ST 3817 - STATISTICAL QUALITY CONTROL**

Date : 05/11/2014

Dept. No.

Max. : 100 Marks

Time : 09:00-12:00

**PART - A**

**Answer ALL the questions:**

**(10 x 2 = 20)**

1. Explain type I error and type II error relative to the control chart.
2. What information is provided by the oc curve of a control chart?
3. Explain the difference between specification limits and control limits.
4. What is the estimator of  $\sigma$  when R chart is used?
5. Why np chart cannot be used when the sample size is varying?
6. Explain the need for Q-Q plot.
7. What is the number of defects per million in a (i)  $6\sigma$  product? and  
(ii)  $3\sigma$  product?
8. What is the need for a CUSUM chart?
9. What are the advantages of multivariate control charts?
10. How should the lots be chosen in acceptance sampling?

**PART - B**

**Answer any FIVE questions:**

**(5 X 8 = 40)**

11. Explain the 3 methods of construction control charts for u (number of defects per unit) when the number of units inspected is varying?
12. A fraction non-conforming chart (p) with center line 0.10, UCL = 0.19, LCL = 0.01 is used to control a process.
  - (i) Find the sample size if  $3\sigma$  limits are used.
  - (ii) Find the probability of type I error.
  - (iii) Find the ARL if the process has shifted to  $p = 0.2$
13. A process is in statistical control with  $\bar{X} = 39.7$  and  $\bar{R} = 2.5$ ,  $n = 2$  specifications are  $40 \pm 5$ . The quality characteristic is normally distributed.
  - (a) Estimate the potential capability
  - (b) Estimate the actual capability
  - (c) Obtain  $C_{pm}$
  - (d) can the process be improved?
14. How do you analyze patterns in the control chart?
15. When do we use attribute control charts and control chart for individuals?
16. Explain the double sampling plan and obtain the expressions for AOQ and ATI.
17. Consider improving service quality in the college office. What are KPIV's and KPOV's that you should consider? How do these relate to student CTQ's?
18. (i) Explain the method of drawing oc curve for a p-chart.
  - (ii) An oc curve gives the probability of a point falling outside the limits as 0.35. When there is a change in the process, what is the probability of detecting this shift in the second sample following the shift?

**PART- C**

**Answer any TWO questions:**

**( 2 X 20 = 40)**

19. (a) When do you need S chart? (2)  
(b) Obtain the control limits for  $\bar{X}$  and S chart. (8)  
(c) Control charts for  $\bar{X}$  and S have been maintained on a process and have exhibited statistical control. For  $n = 6$

$\bar{X}$ chart	S chart
UCL = 708.2	UCL = 3.42
CL = 706	CL = 1.738
LCL = 703.8	LCL = 0.052

- (i) Obtain the estimate of process mean and standard deviation. (2)  
(ii) Estimate the natural tolerance limits. (2)  
(iii) If the specifications are 703 and 709 estimate the fraction nonconforming. (3)  
(iv) If the process shifts to 702, what is the probability of detecting this shift? (3)  
(The process is normally distributed, with same  $\sigma$ )
20. (a) Explain the advantages of using EWMA chart. (3)  
(b) Explain the method of tabular CUSUM. (5)  
(c) Prepare a tubular CUSUM for the following data with  $\mu = 100$ ,  $K = 3$ ,  $H = 12$   
 $X_i$  values are 107, 102, 109, 98, 105, 110. (6)  
(d) Repeat the calculations with a Headstart of  $H/2 = 6$ . What conclusions you draw? (6)
21. (a) Explain the principle component analysis method of multivariate control charts.  
(b) Draw the OC curve for a single sampling plan  $n = 100$  and  $c = 2$ . Also obtain the expressions for AOQ and ATI after rectification.
22. Explain the DMAIC procedure in detail.

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