 LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

**M.Sc.** DEGREE EXAMINATION - **STATISTICS**

FOURTH SEMESTER – APRIL 2011

# ST 4810 / 4806 - STATISTICAL PROCESS CONTROL

Date : 07-04-2011 Dept. No. Max. : 100 Marks

Time : 9:00 - 12:00

**Part-A**

Answer **ALL** the questions: (10 X 2 = 20)

1. When do you say that a process is in statistical control when a control chart is used?
2. Write the control limits for the np-chart when the process fraction defective is 0.02.
3. Write the need for CUSUM chart.
4. Explain process capability.
5. What are the advantages of multivariate control charts?
6. Explain the terms LTPD and AQL.
7. Mention any two uses of an OC curve for control charts.
8. What is the need for acceptance sampling?
9. Write down the Shewart control limits for individual measurements.
10. When do you prefer S chart to R chart?

**Part-B**

Answer any **FIVE** questions only: (5 X 8 = 40)

1. A fraction non conforming control chart is to be established with center line=0.20 and three sigma limits. What is the sample size required to yield a positive lower control limit? What is the value of n necessary to give a probability of 0.50 of detecting a shift in the process to 0.26 ?
2. A paper mill uses a control chart to monitor the imperfection in finished rolls of paper. Production output is inspected for 10 days and the resulting data is given. Set up an appropriate control chart to find statistical control.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| No. of rolls | 18 | 18 | 24 | 22 | 22 | 22 | 20 | 20 | 20 | 20 |
| No. of defects | 12 | 14 | 20 | 18 | 15 | 12 | 11 | 15 | 12 | 10 |

1. Discuss the advantages of using control charts? How do you choose rational subgroups?
2. Explain how principal components can be used in multivariate control charts.
3. Explain double sampling plan and obtain the expression for AOQ and ATI.
4. A molecular weight of particular polymer should fall between 2100 and 2350. 50 samples were taken and gave = 2275, S = 60.Assuming normality obtain the 95% confidence interval for cP and cpk.
5. Explain chain sampling plan.
6. Explain how CUSUM chart can be used to study variability.

Part-C

Answer any **TWO** questions: (2 x20 = 40)

19.a) Derive the control limits for and s chart.

b) A normally distributed quality characteristic is monitored by using R chart.Sample size n=4.

chart R-chart

UCL= 626 UCL=18.795

CL= 620 CL=8.236

LCL=614 LCL=0

Both charts exhibit control.

1. Suppose an s-chart were to be used, what would be the parameters of s-chart?
2. If specifications are 610 15 what would be your estimate of fraction non conforming.
3. If the process shifts to new mean 610, what is the probability of detecting the shift in the second sample following the shift?
4. What is the ARL when the process mean is 610?
5. What is the α-risk associated with the - chart?

20.a) Derive the control limits for EWMA chart .

b) The following data represents individual observations of a molecular weight taken hourly from a

chemical process. The target value of a molecular weight is 1050 and σ=25.Set up a tabular

column to detect a shift of 1.0 σ in the process mean.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sl.No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| X | 1045 | 1055 | 1037 | 1064 | 1095 | 1008 | 1050 | 1087 | 1125 | 1146 |

21.a) Explain the multivariate control charts by using Hotelling T2  and chi-square.

b) Consider the two processes given in the following table.

|  |  |
| --- | --- |
| Process A | Process B |
| =100 | =105 |
| =3 | =1 |

Specifications are 100 10.Calculate cp, cpk, cpm  and interpret these ratios. Which process

would you prefer to use ?

22.a) Draw the OC curve for a Single Sampling Plan with n=100, c=2.

b) Find a Single Sampling Plan for which

p1  =0.02,α=0.01, p2 =0.06,β=0.10.

c) Explain the two methods of Variable Sampling Plans based on fraction of defectives.

(8+5+7)

\*\*\*\*\*\*\*\*