

BITS, PILANI – DUBAI
Second Semester IV Year Elective
2008 – 2009

Comprehensive Exam (Closed book)

(Statistical data books are allowed. Graph sheets may be used for drawing charts)

Course No & Title : ME C443 Quality Control Assurance & Reliability

Date: 28/05/2009

Time 10.00 AM to 1.00 PM

Max: 80 marks

Answer All Questions

1. Briefly explain the different stages associated with quality improvement (5)
2. Compare and contrast the different philosophies of Deming, Crosby and Juran. (10)

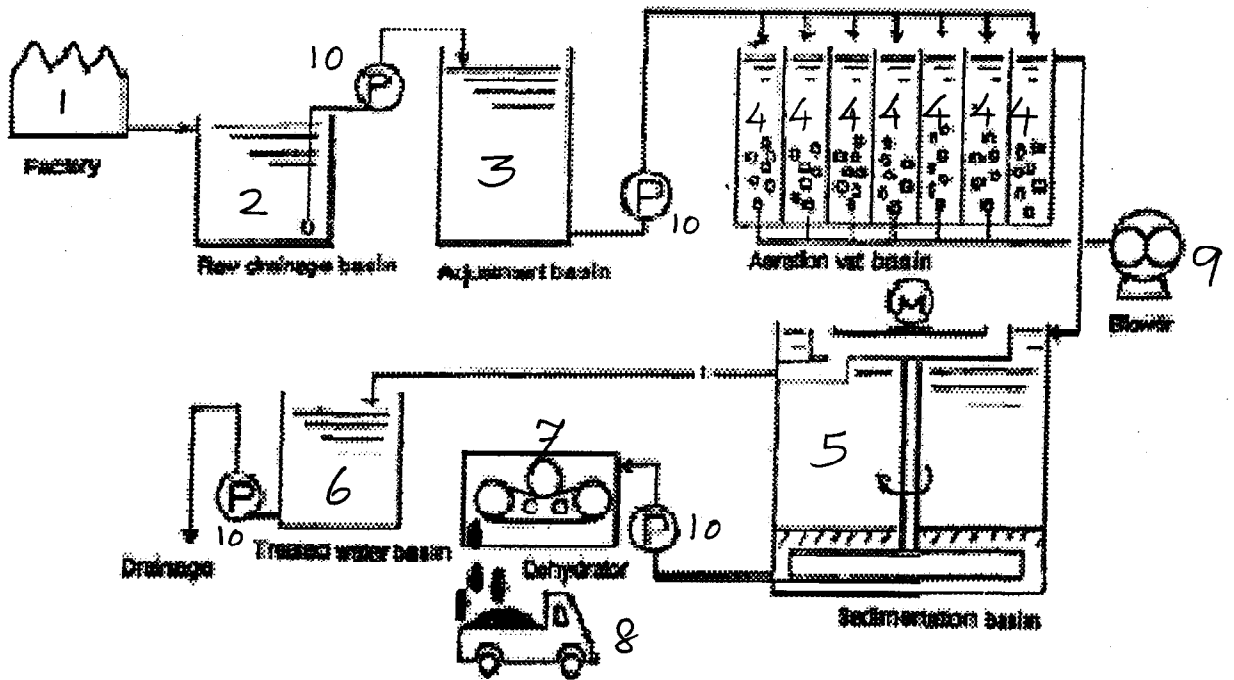
3. ABC Company has ordered 15 computers. Unknown to the company, three of the computers have some defects. If the purchasing department selects five computers from the shipment, what is the probability that none of them will have defects? What is the probability that no more than two will be defective in that sample of five computers? (5)

4. The Dubal company in Jabelali is generating electricity and utilizing it to produce aluminum. The monthly use is known to be normal with a mean of 1000 MWh with a standard deviation of 50 MWh.
 - (a) What is the probability that the monthly consumption will be less than 980 MWh?
 - (b) What is the probability that the monthly consumption will be between 950 MWh and 1050 MWh?
 - (c) The Generating capacity of the power plant is 1100 MWh. What is the probability that the demand will not exceed this limit? (10)

5. A QC engineer likes to examine the difference in the proportion of defective components produced by two operators. A random sample of 100 parts from the first operator shows that 6 components are defective. Another sample of 200 components from the second operator shows that 8 components are defective. Find the range of variation in the two operators defect proportion in the production of that component with a 90% confidence. (5)

6. Past data on the diameter of cotter pin production shows the process mean as 15 mm with a standard deviation of 0.8 mm. if the sample size of 4 are chosen:
 - (a) Find the 3σ control limits for the mean diameter.
 - (b) If the process mean shifts to 14.5 mm, what is the probability of non detecting this shift on the first sample obtained after the shift?
 - (c) What is the probability of failing to detect the shift by the second sample after the shift?
 - (d) Construct an OC curve for the probability of non detection of process mean shift.
 - (e) Construct the ARL curve for the probability of detection of shift in mean. (10)

7. An analyst wishes to estimate the thickness of magnetic coating on an audio tape. Random samples of size 4 are selected. Following table shows the mean and standard deviation for 10 samples. The specifications are 36 ± 2.5 microns. If a coating thickness is less than the specifications call for, the tape can be used for a different purposes by running it through another coating operation
 - a. Find the trial control limits for an X and s chart.
 - b. Assuming special causes for the out of control points, determine the revised control limits.
 - c. Assuming the thickness of the coating is normally distributed, what proportion of the product will not meet specifications?
 - d. If the process average shifts to 37.8 microns, what proportion of the product will be acceptable? (10)



Waste Water Treatment Process

- 1-Factory Outlet 2-Drainage basin 3-Aquifer basin 4-Aeration Basin
- 5-Sedimentation basin 6-Treated water basin 7-Dehydrator 8-Transport Vehicle
- 9-Blower 10-Pump

| Sample | Sample Mean | Sample standard deviation |
|--------|-------------|---------------------------|
| 1 | 36.4 | 4.6 |
| 2 | 35.8 | 3.7 |
| 3 | 37.3 | 5.2 |
| 4 | 33.9 | 4.3 |
| 5 | 37 | 4.4 |
| 6 | 35 | 3.9 |
| 7 | 38.6 | 5 |
| 8 | 39.4 | 6.1 |
| 9 | 34.4 | 4.1 |
| 10 | 39.5 | 5.8 |

8. Data for the number of dissatisfied customers in a department store observed for 10 samples of size 300 is given below. Construct an np- chart for the number of dissatisfied customers. Also construct an OC curve as a function of average number of dissatisfied customers and comment on the OC curve. (10)

| Sample | Sample Mean |
|--------|-------------|
| 1 | 13 |
| 2 | 10 |
| 3 | 8 |
| 4 | 9 |
| 5 | 6 |
| 6 | 19 |
| 7 | 10 |
| 8 | 21 |
| 9 | 7 |
| 10 | 8 |

9. An optical sensor has a Weibull time to failure distribution with a scale parameter of 300 h and a shape parameter of 0.5. What is the reliability of the sensor after 500 h of operation? Find the mean time to failure. Is the failure rate increases or decreases with time? Identify the phase in which the components are. (10) (5)
- 10 The figure shown in the backside shows a typical waste water treatment process flow chart. The reliability of each stage of the process is given below. Draw a block diagram representing the process indicating the parallel and series process flow. Also find out the system reliability of the waste water treatment process.

| Process component No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|--------------------------------|----|----|----|----|----|----|----|----|----|----|
| Reliability of the component % | 98 | 96 | 93 | 94 | 91 | 95 | 94 | 92 | 92 | 93 |

(10 MARKS)

Best of Luck!!!

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Test II (open Book)

Course No & Title : ME C443 Quality Control Assurance & Reliability

Date : 10/05/2009

Time 50 minutes

Max: 20 marks

Answer All Questions

1. Following are the data obtained from the impact test on helmets by crushing in a hydraulic press. The load at which the helmets were broken is listed for 10 days. Find out the variability of the process of manufacturing the helmets by plotting a suitable control chart. Justify your selection of a particular type of chart.

| Days | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-----------------------------|-------|------|------|------|------|------|------|------|-------|------|
| Crash strength kg/square cm | 27.53 | 36.5 | 38.4 | 24.5 | 39.7 | 52.3 | 44.7 | 32.7 | 45.10 | 36.5 |

(6 MARKS)

2. A company is interested in determining whether the following data pertaining to its automotive ancillary unit's brake shoe production line are under control or not. Also it is desired to have an OC curve for the Type II error involved with the proportion of nonconforming components. A random sample of 100 items was chosen for ten days and the number of nonconforming items is given below. The items were supplied to a popular car manufacturer and they specified that the acceptance level as 3% or less. Also find the number components that get rejected by the specification limit.

| Sample No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-------------------------------|---|---|---|---|---|---|---|---|----|----|
| Number of Nonconforming items | 3 | 6 | 3 | 4 | 9 | 5 | 4 | 2 | 10 | 6 |

(10 MARKS)

3. The figure shown in the backside shows part of bear making process flow chart. The reliability of each stage of the process is given below. Draw a block diagram representing the process indicating the parallel and series process flow. Also find out the system reliability of the bear making process.

| Process component No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|--------------------------------|----|----|----|----|----|----|----|----|----|----|----|
| Reliability of the component % | 98 | 96 | 93 | 94 | 99 | 95 | 94 | 92 | 93 | 97 | 98 |

(9 MARKS)

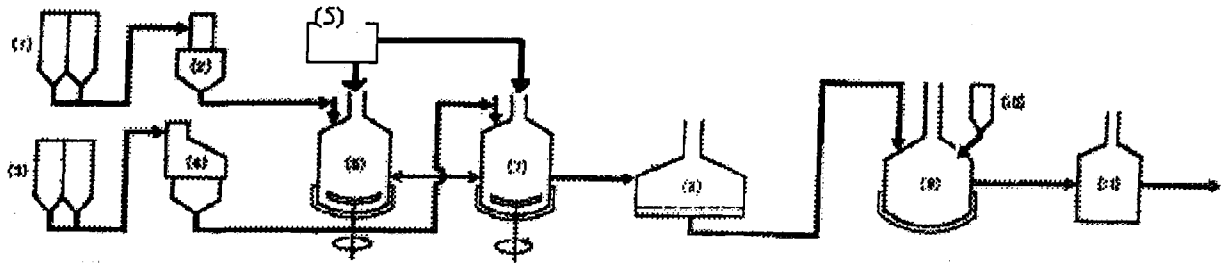


Figure : Beer manufacturing process flow chart.

1) Barley Silo 2) Barley crusher and hopper 3)Malt silo 4) malt crusher and hopper 5) hot water tank (6)&(7) Mixing tanks 8) filter vat 9) Boiling vat 10) congealing agent tank 11) filtration tank.

Best of Luck!!!

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Test I

Course No & Title : ME C443 Quality Control Assurance & Reliability

Date : 02/04/2009

Time 50 minutes

Max: 25 marks

Answer All Questions

(Approved Statistical Data sheets allowed)

1. What are the major categories of quality costs? Briefly explain them by giving examples.

(4 MARKS)
2. A company is interested in determining whether the performance of two vendors is same or different. A random sample 100 items from the first vendor revealed 5 non conforming items. A random sample of 175 items from the second vendor showed 10 nonconforming items. What is your conclusion based on their proportion of non conforming items. Test at the level of significance of 0.05.

(5 MARKS)
3. The length of industrial filters is a quality characteristic of interest. Thirty samples, each of size 5 are chosen from the manufacturing line. The data yields an average length of 110 mm, with a standard deviation of 3 mm.
 - (a) Find the warning and control limits
 - (b) If the process mean shifts to 112 mm what are the chances of detecting this by second sample drawn after the shift?
 - (c) What is the ARL for a shift in the process mean to 112 mm? How many samples it will take to detect a change in the process mean to 116 mm?

(8 MARKS)
4. Your enterprise is using a process which produces parts whose length has a mean diameter of 50 mm and standard deviation 0.15 mm. You plan to make 100,000 of these parts. You have determined by taking into account the rework cost and the loss of customer satisfaction that the quality loss function for the process is:
$$L = 2250 \sigma^2$$

where σ is the standard deviation of length of the part and L is the average quality lost in AED per part.

A very smart but somewhat expensive IIM graduate has offered you her expert advice on your process. For every 0.01 mm reduction in the standard deviation of the length of the part, she will charge AED 6000.

How much of her advice do you buy? (You can buy fractional amounts of her consulting).

(8 MARKS)

Best of Luck!!!

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Quiz II

Course No & Title : ME C443 Quality Control Assurance & Reliability

Answer All Questions (10X 1=10 marks)

1. The power of significance test is
 - a) = P(Rejecting H_0/H_0 is true)
 - b) = P(Accepting/ H_0 is false)
 - c) = P(Accepting H_0/H_0 is true)
 - d) = P(Rejecting H_0/H_0 is false)

2. The cause and effect diagrams were developed by _____

3. For the out of control process the ARL is equal to _____

4. The other name of control chart is _____

5. If you choose the 3σ control limits then there is a chance of _____ of sample points to fall within the control limits.

6. When all other parameters are fixed, the probability of Type II error will increase with increase of sample size(T/F)

7. For a process in control the ARL is equal to _____

8. The important quality characteristics are identified using _____ diagram.

9. Write down the different rules that help in identifying out of control process.(2 marks)

Name: _____

ID: _____

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Quiz I

Course No & Title : ME C443 Quality Control Assurance & Reliability

Answer All Questions (10X 1=10 marks)

1. The Weibull distribution approaches to normal distribution for $\gamma=0$, $\alpha= 1$ and $\beta=$ _____
2. The median of the following sample group is _____
45.3, 44.5, 43.5, 44.7, 45.8, 44.7, 43.9, 44.6, 45.9, 43.6
3. When the kurtosis coefficient is _____, the distribution is called leptokurtic distribution.
4. The range of correlation coefficient always will be between _____ and _____.
5. The binomial distribution is represented by two parameters. They are _____ and _____.
6. The value of the gamma function(Γ) for an integer 'n' is given by _____.
7. The mean of a binomial distribution is equal to 10. Calculate the Variance.

8. The mean and standard deviation of a normal distribution are 10 and 2, respectively. Calculate the value of standardized normal random variable for the sample value of 11.

9. The failure rate of an electric bulb is 0.01/h. What is the mean life of the bulb?. Assume that exponential distribution can be used to model the life cycle of the electric bulbs.

10. Differentiate the positive and negatively skewed distributions.

Best of Luck!!!!