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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February / March 2023 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Industrial Engineering and Management **Duration: 3 hrs.**
Course Code: 20IM5DCQAR **Max Marks: 100**
Course: Quality Assurance and Reliability **Date: 21.02.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

UNIT - I

1 a) Discuss the eight dimensions of Quality as proposed by Garvin. Take an example of any product related to machine tool manufacturing for example a collete, a sleeve, a spindle etc. that you are familiar with and explain how these dimensions can be perceived while assessing the Quality aspect of this product example. **10**

b) "**Quality costs can be classified as appraisal costs, prevention costs, internal failure costs and external failure costs".** Discuss in detail the components of costs within each of these four categories of Quality costs. **10**

UNIT - II

2 a) Imagine you are given the responsibility of developing a plan for systematically instituting a Quality Assurance Systems for monitoring the Quality of outputs from a small manufacturing plant. Outline the activities involved for setting up the Quality Assurance processes and systems. **10**

b) What are chance and assignable causes of variability? Give one example each. Justify the statement that **"variability attributable to chance causes cannot be eliminated easily due to economic reasons"** by giving suitable examples. What part do the system of classifying causes as chance causes and assignable causes play in the operation and interpretation of a Shewhart control chart? **10**

OR

3 a) Discuss the logic underlying the use of three-sigma limits on Shewhart control charts. How will the chart respond if narrower limits are chosen? How will it respond if wider limits are chosen? When taking samples or subgroups from a process, do you want assignable causes occurring within the subgroups or between them? Fully explain your answer. **10**

b) Is there a particular sequence in which the seven QC tools have to be applied for solving a Quality problem in real life manufacturing or service situations? Why? Or Why not? Discuss how each of the tools provides the analyst with a different data or fact based insights into the Quality problem being solved. **10**

UNIT - III

4 a) Samples of n = 6 items each are taken from a process at regular intervals. A quality characteristic is measured; Xbar and R values are calculated for each sample. After 50 samples, we have **15**

$$\sum_{1}^{50} Xbar = 2000, \sum_{1}^{50} R = 200$$

Assume that the quality characteristic is normally distributed.

i. Compute control limits for the Xbar and R control charts.
ii. All points on both control charts fall between the control limits computed in part (i). What are the natural tolerance limits of the process?
iii. If the specification limits are 41 ± 5.0, what are your conclusions regarding the ability of the process to produce items within these specifications?
iv. Assuming that if an item exceeds the upper specification, limit it can be reworked and if it is below the lower specification limit it must be scrapped, what percent scrap and rework is the process producing?
v. Make suggestions as to how the process performance could be improved

b) What is the need for homogenization while revising the control limits? Briefly outline the process of homogenization. **05**

OR

5 a) A company purchases a small metal bracket in containers of 5000 each. Ten containers have arrived at the unloading facility, and 250 brackets are selected at random from each container. The fraction non-conforming in each sample are 0, 0, 0, 0.004, 0.008, 0.020, 0.004, 0, 0, and 0.008. Do the data from this shipment indicate statistical control? **08**

b) A process is controlled with a fraction nonconforming control chart with three-sigma limits, n = 100, UCL = 0.161, center line = 0.080, and LCL = 0. **12**

(i) Find the equivalent control chart for the number nonconforming.
(ii) Use the Poisson approximation to the binomial to find the probability of a type I error.
(iii) Use the correct approximation to find the probability of a type II error if the process fraction nonconforming shifts to 0.2.
(iv) What is the probability of detecting the shift in part (iii) by at most the fourth sample after the shift?

UNIT - IV

6 a) Suppose that a product is shipped in lots of size N = 5000. The receiving inspection procedure used is singlesampling with n = 50 and c = 1. **12**

(i) Draw the type-B OC curve for this plan and compare it to the type-A OC curve found in part (i).

b) Define the following terms clearly with suitable illustrations **08**

i. Average outgoing quality limit.
ii. Average sample number.
iii. Average total inspection.
iv. Lot tolerance percent defective (LTPD).

UNIT - V

7 a) Graphically Illustrate the common failure rate curve (Bath tub curve). Discuss the causes of failures in each of the regions of the bath tub curve. How do you prevent failures due to causes inherent in each of the regions of the bathtub curve? **08**

b) Given that a particular component has a constant failure rate and failures follows an exponential destination with λ =0.0005 failures per hour, Determine the reliability of the component for (i) t =10 hours (ii) t = 20 hours (iii) t = 50 hours (iv) t=1000 hours (v) t = 10,000 hours. **12**

Plot the time versus reliability graph and draw inferences on the plot that you have obtained.

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