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Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)



## VII SEMESTER B.TECH (AUTOMOBILE ENGINEERING) END SEMESTER EXAMINATIONS, DEC 2015/JAN 2016

SUBJECT: QUALITY CONTROL AND RELIABILITY ENGINEERING-PROGRAM ELECTIVE-IV [AAE-479]

## **REVISED CREDIT SYSTEM**

Time: 3 Hours

MAX. MARKS: 50

## Instructions to Candidates:

- ✤ Answer ANY FIVE FULL the questions.
- ✤ Missing data may be suitable assumed.
- ✤ Use of statistical data is permitted
- **1A.** In an electro-hydraulic braking system, the information about the position of the braking pedal is sent electronically to the braking systems at the wheels. There, the information is transformed by the control unit and the brakes into braking force. If the electronic connection fails, a hydraulic fall-back path takes over which works like a traditional brake. In the control software, the decision of switching from the electronic to the hydraulic path is, among others, based on a threshold value on the time difference between changing the position of the braking pedal and the corresponding increase of braking pressure. As it turned out, this threshold was beginning to be exceeded after a long period of usage although the brakes were still fully functional. So, the control system switched to the hydraulic fall-back path in many cases and the car manufacturer had to initiate a re-call. Specify what is a defect, a fault and a failure in this case with respect to the car as the overall system
- 1B. A company decided to employ control charts for X-bar and R to study variations (07) in the outside diameter of a bearing. The subgroup size is 5. The values of X-bar and R are computed for each subgroup. After 20 subgroups ΣX-bar =71.283 and ΣR = 0.180. The diameter specification for the product is 2.22 ± 0.-02. Compute the control limits for X and R charts. If the process is in statistical control and normally distributed, what can you conclude regarding its ability to meet the specification?
- **2A** Describe the methods for evaluating service quality

(05)

- 2B. A double sampling plan for a lot size of 5000 is given below.
  n<sub>1</sub> = 40, c<sub>1</sub> = 1, r<sub>1</sub> = 4, n<sub>2</sub> = 60, C<sub>2</sub> = 5, r<sub>2</sub> = 6.
  For a lot proportion nonconforming value of p = 0.03, find the probability of accepting such lots.
- 3A. The number of customers who are not satisfied with the service provided in a (06) retail store is found for 20 samples of size 100 and is shown in the table below. Construct a control chart for the proportion of dissatisfied customers. Revise the control limits assuming special causes for the points outside the control limits.

Sample	Number of	Sample	Number of dissatisfied
	dissatisfied customers		customers
1	2	11	5
2	5	12	4
3	4	13	2
4	3	14	5
5	4	15	3
6	2	16	12
7	3	17	3
8	2	18	2
9	4	19	5
10	11	20	2

**3B.** The failure rate of a module is  $\lambda = 10^{-4}$ h<sup>-1</sup> and constant.

(02)

(05)

- (i) Calculate the mean time to failure (MTTF).
   (ii) Calculate the mean time to failure of a system
- (ii) Calculate the mean time to failure of a system consisting of two of these modules. Each module is required by the system and they work independently among each other.

## **3C.** Describe process capability in brief.

(02)

- 4A. What is the reason for variation in the statistical data? Explain the causes for (05) the same.
- **4B.** With neat diagram describe the rules for analysing the control charts **(05)**
- **5A.** List and explain the costs associated with quality. (05)
- 5B. Explain the difference in interpretation between an observation falling below (03) the lower control limit on an X-chart and one falling below the lower control limit on at R-chart.

- **5C.** Distinguish clearly between quality control and inspection.
- **6A.** A system consists of seven modules which have an identical failure rate of  $\lambda = (05)$ 10<sup>-4</sup>h<sup>-1</sup>. Calculate the reliability of a system for an up time of t = 1000 hours, if the modules' dependencies are as indicated in the block diagram in figure.



- **6B.** Describe the methods to improve the reliability of component/system. (03)
- **6C.** Distinguish clearly between quality control and inspection. (02)

(02)