Indian Statistical Institute, Bangalore
M.S (QMS) First Year
Second Semester - Reliability, Maintainability and Safety II

Final Exam   Duration: 2hrs   Date: 08th May 2015

Answer as many as you can but one can score maximum 100 marks only

1. State whether the following statements are true or false. Give brief justification (Proof not required) for your statement. Statements with out justification will not carry any marks.
   a. Availability of a repairable product or system can be higher than its reliability.
   b. Warranty cost to the manufacturer of a product depends only on the reliability of the system.
   c. Fault Tree Analysis (FTA) is used to assess the risks involved in the potential failure modes of a product/system.
   d. If the line fitted to the life data in a Weibull probability paper, after improvement of the design, is parallel and moved to the right of the line related to the life data prior to the improvement, it will indicate increase in the failure rate and change in the nature of failures.
   e. Eyring model used for accelerated life testing of a product /system covers the stress factors as humidity and vibration.   (5*5=25)

2. For repairable system the failure rate is 0.01/ hr. A sample of the recent repair times are 15, 7.5, 6.2, 1.5, 2.5, 0.5 hours. Assuming exponential distribution for the failure and repair times calculate its steady state availability.   (10)

3. An accelerated life test was conducted for an electronic system. As some semiconductor components are the most sensitive components for the system failures, the operating temperature was considered for the acceleration of the failures. Arrhenius Model is considered and test on a sample of 5 systems was conducted at 95© (Degrees Centigrade). Test for all the systems was terminated prior to failure at different time points (prior to occurrence of the considered failure mode) as given below:

   2000, 1500, 850, 1420, 5120 hours.

   Considering the failure times are exponentially distributed and the normal operating temperature is 40© (Degrees Centigrade), calculate the 95% lower confidence limit for the reliability of the system for 1000 hours of operation. (Consider the Boltzman Constant as 1/11605 and the activation energy (Ea) as 1.1 electron Volts.)   (25)

4. A Hydraulic system has two identical valves which are connected in series. If the valves can have failure modes with respect to open and closed modes of operation then compute the reliability of the system for a period of 10,000 operations. Failure rates for opening and closing of the valves are 0.001/1000 operations and 0.0005/1000 operations respectively. Note : The system is considered working if there is no failure of close mode and open modes of operation.   (15)

5. Write Short Notes on the following:
   a. Failure Mode and Effect Analysis
   b. Homogeneous Poisson Process (HPP)
   c. Safety Factor in relation to Product Design
   d. Maintainability of a Product
   e. Life Cycle Cost of a consumer product.   (5*7=35)