EE5903 RTS – Chapter 3 Practice Problems

1. The time-to-fail T (in hours) of an electronic sub-component has the following probability density function:

$$f(t) = \begin{cases} \dfrac{3t^2}{10^9} & ; \quad 0 \le t \le 1000 \\ 0 & ; \quad t > 1000 \end{cases}$$

   (a) Show that f(t) is a valid probability density function and hence determine the cumulative distribution function (fallibility function) F(t) and reliability function R(t).

   (b) What is the reliability at 500 hours ?

   (c) What is the probability that the sub-component will fail in the first 100 hours of operation ?

   (d) Determine the *design life-time** for a reliability exceeding 0.99.

   (e) Determine the failure rate.

2. The reliability of a multi-core CPU system at time t (hours) is given by:

$$R(t) = \begin{cases} \left(1 - \dfrac{t}{t_o}\right)^2 & ; \quad 0 \le t \le t_o \\ 0 & ; \quad t > t_o \end{cases}$$

   where t_o is the maximum life-time of the CPU system.

   (a) Detemine the failure rate.

   (b) Determine the MTTF.

   (c) Determine the *design life-time** for a reliability exceeding 0.90 when t_o is 5,000 hours.

* The design life-time is defined as the interval of time when the reliability exceeds a certain level.

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3. A component has a constant failure rate with an MTTF of 1100 hour.

   (a) Determine the failure rate.

   (b) Determine the reliability at 200 hours.

   (c) What is the *design life-time** for a reliability exceeding 0.95 ?

4. When turned-on, a computing component has a Weibull failure distribution with a shape parameter of 1.4 and a characteristic life of 550 hours. When installed in a system (as a back up), it is not turned-on until 200 hours have elapsed.

   (a) Write down the reliability function of the component on its own and when installed in the system.

   (b) Determine the reliability of the component when installed in the system at 100 hr and 300 hr.

   (c) Determine the MTTF of the component when installed in the system.

Verify your answers:

1b: 0.875	1c: 0.001	1d: 215 hr	1e: 750 hr
2a: $2/(t_o - t)$	2b: $t_o/3$	2c: 257 hr	
3a: $9.09 \times 10^{-4}\ hr^{-1}$	3b: 0.834	3c: 56 hr	