Assignment 05

This assignment consists of 7 problems. Problems 3, 4, 6, 9, 10, 12, 13 from 235-237 page.

Problem #3:
The failure rate for a certain type of a component is $\lambda(t) = at$ (t ≥ 0), where a > 0 and is constant. Find the component's reliability, and its expected life (or MTTF).

Problem #4:
Two alternative workstations are being considered for acquisition. Workstation A consists of 10 chips, each with a constant failure rate of $10^{-5}h^{-1}$ and all 10 chips must function properly for the system to function. Workstation B consists of five chips, each having a time-dependent failure rate give by at per hour, for some constant a and all five chips must function properly for the workstation to function. If both workstations have the same mean time to failure, which one should be recommended? Assume that the reliability for a mission time of 1000 h is the criterion for selection.

Problem #6:
The failure rate of a device is given by

$$h(t) = \begin{cases} at, & 0 < t < 1000h, \\ b, & t \geq 1000h \end{cases}$$

Choose b so that *h(t)* is continuous, and find an expression for device reliability.

Problem #9:
Consider a parallel redundant system of two independent components with the lifetime of ith component $X_i \sim EXP(\lambda_i)$. Show that system MTTF is given by

$$MTTF = \frac{1}{\lambda_1} + \frac{1}{\lambda_2} - \frac{1}{\lambda_1 + \lambda_2}.$$

Generalize to the case of n components. Next consider a standby redundant system consisting these two components. Assuming that the component in the spare status does not fail, obtain the reliability and the MTTF of the system.

Problem #10:
Compare the reliability of the workstation and the file server example (see Example 3.21 and 4.16) under the exponential and Weibull failure distribution assumptions. To make a fair comparison, choose Weibull scale parameters in such way that the MTTFs of individual workstation and the file server under the two assumptions are the same. Assume $l = m = k = 2$, $n = 3$, $MTTF_f$ = 200 h, $MTTF_w$ = 1000 h. Choose shape parameter $\alpha = 0.5$.

Problem #12:
Recall Example 1.21. Assuming constant failure rates $\lambda_i, (i \in \{x, p, d, c\})$ for an XCVR, a pass-thru, a duplexer and a combiner, respectively, write down the system reliability and system MTTF expressions.

Problem #13:
An airplane has four propellers, two on each side[LEEM 1995]. The airplane will fly (or function correctly) if atleast one propeller on each wing functions. Assuming that each propeller has a constant failure rate λ, find explicit expressions for system reliability and system MTTF.