Assignment 2

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12.10 To calculate this answer, I will assume that the devices fail independently. I begin by calculating the MTBF for one device.

$$\begin{aligned}\lambda &= \frac{22}{1,000,000} \\ &= 0.000022 \\ \text{MTBF} &= \frac{1}{0.000022} \\ &= 54,545.\overline{54}\end{aligned}$$

And now I calculate the MTBF for three devices.

$$\begin{aligned}\text{MTBF} &= 3 \times 54,545.\overline{54} \\ \text{MTBF} &= 136,363.\overline{63} \text{ hours.}\end{aligned}$$

12.11 To calculate *reliability*, I will use the following function:

$$R(t) = 1 - F(t)$$

And I will calculate $f(t)$ as:

$$f(t) = \frac{1}{\theta} e^{\frac{-t}{\theta}}$$

Values for $t = 200$ and $\lambda = 0.003$ are given.

$$\begin{aligned}f(t) &= 0.003 \times e^{\frac{-200}{33333}} \\ &= 0.003 \times e^{-0.6} \\ &\approx 0.003 \times 0.548811636 \\ &\approx 0.001646435 \\ R(t) &\approx 1 - 0.001646435 \\ &\approx 0.998353565\end{aligned}$$

12.12 I begin by calculating the failure rate, λ for each of the five systems over 1000 hours using the method

applied in 12.11.

$$f(t(\text{Subsystem A})) = \frac{1}{10540} \approx 0.000094877$$
$$f(t(\text{Subsystem B})) = \frac{1}{16220} \approx 0.000061652$$
$$f(t(\text{Subsystem C})) = \frac{1}{9500} \approx 0.000105263$$
$$f(t(\text{Subsystem D})) = \frac{1}{12100} \approx 0.000082645$$
$$f(t(\text{Subsystem E})) = \frac{1}{3600} \approx 0.000\overline{277}$$

Since the subsystems are connected in series, I calculate the probability of survival as follows:

$$R = e^{\frac{-1000}{0.000622215}} \approx 0.5368$$

12.13 I begin by calculating the individual λ for each component.

$$\lambda_1 = \frac{1}{30} = 0.0\overline{33}$$
$$\lambda_2 = \frac{1}{85} = 0.011764706$$
$$\lambda_3 = \frac{1}{220} = 0.00\overline{45}$$
$$\lambda_4 = \frac{1}{435} = 0.002298851$$
$$\lambda_5 = \frac{0}{500} = 0.0$$
$$\lambda_6 = \frac{0}{500} = 0.0$$
$$\lambda_7 = \frac{0}{500} = 0.0$$
$$\lambda_8 = \frac{0}{500} = 0.0$$
$$\lambda_9 = \frac{0}{500} = 0.0$$
$$\lambda_{10} = \frac{0}{500} = 0.0$$

The composite failure rate is given as the sum of the individual failure rates: 0.051613557.

12.14

Component	**Failure Rate**	**Quantity**	**Extension**
A	0.135	16	2.16
B	0.121	75	9.075
C	0.225	32	7.2
D	0.323	44	14.212
E	0.12	60	7.2
F	0.118	15	1.77
G	0.092	28	2.576
$\lambda = 44.193\%$ / 1000 hours			$\sum = 44.193$
MTBF $= \frac{1000}{0.44193} = 2{,}262.80$ hours.			