SZS Blatt 2

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Aufgabe 1

a)

b)

c)

d)

e)

f)

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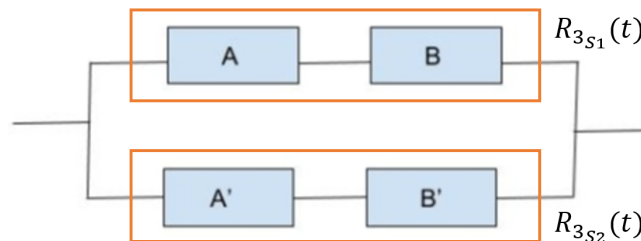
Aufgabe 2

a)

Abbildung 2: RBD für die serielle Komposition

$$R_2(t) = R_A(t) * R_B(t) \tag{1}$$
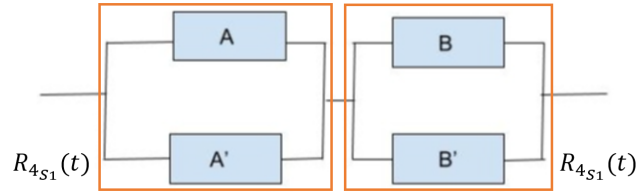
Abbildung 3: RBD für die Systemredundanz

$$R_{3_{S1}}(t) = R_A(t) * R_B(t) \tag{2}$$

$$R_{3_{S2}}(t) = R_{A'}(t) * R_{B'}(t) \tag{3}$$

$$
\begin{aligned}
R_3(t) &= 1 - [(1 - R_{3_{S1}}(t)) * (1 - R_{3_{S2}}(t))] \\
&= 1 - [(1 - R_A(t) * R_B(t)) * (1 - R_{A'}(t) * R_{B'}(t))] \\
&\Leftrightarrow 1 - [(1 - R_A(t) * R_B(t)) * (1 - R_A(t) * R_B(t))] \\
&= 1 - [(1 - R_A(t) * R_B(t))^2] \\
&= 1 - [1 - 2 * R_A(t) * R_B(t) + R_A(t)^2 * R_B(t)^2] \\
&= R_A(t)^2 * R_B(t)^2 + 2 * R_A(t) * R_B(t)
\end{aligned}
\tag{4}
$$

$$R_3(t) = R_A(t)^2 * R_B(t)^2 - 2 * R_A(t) * R_B(t) \tag{5}$$

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Abbildung 4: RBD für die Komponentenredundanz

$$R_{4_{S_1}}(t) = 1 - [(1 - R_A(t)) * (1 - R_{A'}(t))] \tag{6}$$

$$R_{4_{S_2}}(t) = 1 - [(1 - R_B(t)) * (1 - R_{B'}(t))] \tag{7}$$

$$
\begin{aligned}
R_4(t) &= R_{4_{S_1}}(t) * R_{4_{S_2}}(t) \\
&= (1 - [(1 - R_A(t)) * (1 - R_{A'}(t))]) * (1 - [(1 - R_B(t)) * (1 - R_{B'}(t))]) \\
&\Leftrightarrow (1 - [(1 - R_A(t)) * (1 - R_A(t))]) * (1 - [(1 - R_B(t)) * (1 - R_B(t))]) \\
&= (1 - (1 - R_A(t))^2) * (1 - (1 - R_B(t))^2) \\
&= (1 - (1 - 2 * R_A(t) + R_A(t)^2)) * (1 - (1 - 2 * R_B(t) + R_B(t)^2)) \\
&= (2 * R_A(t) - R_A(t)^2) * (2 * R_B(t) - R_B(t)^2) \tag{8}
\end{aligned}
$$

$$R_4(t) = (2 * R_A(t) - R_A(t)^2) * (2 * R_B(t) - R_B(t)^2) \tag{9}$$

b)

Beispiel:

$$R_A(t) = R_B(t) = 0.5 \tag{10}$$

$$
\begin{aligned}
R_2(t) &= R_A(t) * R_B(t) \\
&= 0.5 * 0.5 \\
&= 0.25 \\
R_3(t) &= R_A(t)^2 * R_B(t)^2 - 2 * R_A(t) * R_B(t) \\
&= 0.5^2 * 0.5^2 - 2 * 0.5 * 0.5 \\
&= 0.4375 \\
R_4(t) &= (2 * R_A(t) - R_A(t)^2) * (2 * R_B(t) - R_B(t)^2) \\
&= (2 * 0.5 - 0.5^2) * (2 * 0.5 - 0.5^2) \\
&= 0.5625 \tag{11}
\end{aligned}
$$

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Aufgabe 3

a)

$y(x) = m*x + c$

$MTBF_c(t) = \kappa * t^\alpha$

$\Rightarrow y = \log(MTBF_c(t))$

$\Rightarrow m = \alpha$

$\Rightarrow c = \log(\kappa)$

$\Rightarrow x = \log(t)$

b)

$t_1 = 20 \quad MTBF_c(t_1) = 7$

$t_2 = 100 \quad MTBF_c(t_2) = 25$

$MTBF_c(t_1):$

$\Rightarrow 7 = \kappa * 20^\alpha$

$\Rightarrow \kappa = \frac{7}{20^\alpha}$

$MTBF_c(t_2):$

$\Rightarrow 25 = \kappa * 100^\alpha$

mit $\kappa = \frac{7}{20^\alpha} \Rightarrow 25 = \frac{7}{20^\alpha} * 100^\alpha$

$\Rightarrow 25 = \frac{7*100^\alpha}{20^\alpha}$

$\Rightarrow 25 = 7 * (\frac{100}{20})^\alpha$

$\Rightarrow 25 = 7 * 5^\alpha$

$\Rightarrow \alpha = \log_5(\frac{25}{7}) = 0,79$

mit $\alpha = 0,79 \Rightarrow \kappa = \frac{7}{20^{0,79}} = 0,66$

c)

$MTBF_c(200) = 0,66 * 200^{0,79} = 43$

$\lambda_i(100) = 7e^{-\frac{7}{25}*100} = 5$

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