

rechnung_umkehrintegrator

Student Group

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Table of Contents

\$\;\$ \$\;\$	$U_A = f(U_E)$
\$\;\$ \$\;\$	with III.
	$\frac{d}{dt} \left(\frac{1}{C} \int_{t_0}^{t_1} I_C \, dt + Q_0(t_0) \right) = \frac{1}{R} \int_{t_0}^{t_1} U_E \, dt + U_{A0}$
\$\;\$ \$\;\$	$U_A = \frac{1}{C} \int_{t_0}^{t_1} I_C \, dt + Q_0(t_0)$
\$\;\$ \$\;\$	with II. and I.: $\frac{1}{C} \int_{t_0}^{t_1} I_C \, dt = \frac{1}{C} \int_{t_0}^{t_1} I_A \, dt = \frac{1}{C} \int_{t_0}^{t_1} I \, dt$
	$\frac{d}{dt} \left(\frac{1}{C} \int_{t_0}^{t_1} I \, dt + Q_0(t_0) \right) = \frac{1}{R} \int_{t_0}^{t_1} U_E \, dt + U_{A0}$
\$\;\$ \$\;\$	$U_A = \frac{1}{C} \int_{t_0}^{t_1} I \, dt - \frac{Q_0(t_0)}{C}$
\$\;\$ \$\;\$	with V.: $\frac{1}{C} \int_{t_0}^{t_1} I \, dt = \frac{1}{C} \int_{t_0}^{t_1} I_C \, dt + Q_0(t_0)$
	$\frac{d}{dt} \left(\frac{1}{C} \int_{t_0}^{t_1} I_C \, dt + Q_0(t_0) \right) = \frac{1}{R} \int_{t_0}^{t_1} U_E \, dt + U_{A0}$
\$\;\$ \$\;\$	$U_A = \frac{1}{C} \int_{t_0}^{t_1} I_C \, dt + Q_0(t_0)$
\$\;\$ \$\;\$	with IV.: $I_C = I_R$
	$\frac{d}{dt} \left(\frac{1}{C} \int_{t_0}^{t_1} I_R \, dt + Q_0(t_0) \right) = \frac{1}{R} \int_{t_0}^{t_1} U_E \, dt + U_{A0}$
\$\;\$ \$\;\$	$U_A = \frac{1}{C} \int_{t_0}^{t_1} I_R \, dt + Q_0(t_0)$
\$\;\$ \$\;\$	Factor out
	$\frac{d}{dt} \left(\frac{1}{C} \int_{t_0}^{t_1} I_R \, dt + Q_0(t_0) \right) = \frac{1}{R} \int_{t_0}^{t_1} U_E \, dt + U_{A0}$
\$\;\$ \$\;\$	$U_A = -\frac{1}{C} \int_{t_0}^{t_1} I_R \, dt - \frac{Q_0(t_0)}{C}$
\$\;\$ \$\;\$	consider the integration constant: $\frac{Q_0(t_0)}{C} = U_C(t_0) = -U_{A0}$
	$\frac{d}{dt} \left(\frac{1}{C} \int_{t_0}^{t_1} I_R \, dt + U_{A0} \right) = \frac{1}{R} \int_{t_0}^{t_1} U_E \, dt + U_{A0}$
\$\;\$ \$\;\$	$U_A = -\frac{1}{C} \int_{t_0}^{t_1} I_R \, dt + U_{A0}$
\$\;\$ \$\;\$	with VI. and II.: $I_R = \frac{U_R}{R} = \frac{U_E}{R}$
	$\frac{d}{dt} \left(\frac{1}{C} \int_{t_0}^{t_1} \frac{U_E}{R} \, dt + U_{A0} \right) = \frac{1}{R} \int_{t_0}^{t_1} U_E \, dt + U_{A0}$
\$\;\$ \$\;\$	$U_A = -\frac{1}{C} \int_{t_0}^{t_1} \frac{U_E}{R} \, dt + U_{A0}$
\$\;\$ \$\;\$	move constant ahead
	$\frac{d}{dt} \left(\frac{1}{C} \int_{t_0}^{t_1} \frac{U_E}{R} \, dt + U_{A0} \right) = \frac{1}{R} \int_{t_0}^{t_1} U_E \, dt + U_{A0}$
\$\;\$ \$\;\$	$U_A = -\frac{1}{R \cdot C} \int_{t_0}^{t_1} U_E \, dt + U_{A0}$
\$\;\$ \$\;\$	insert time constant $\tau = R \cdot C$
	$\frac{d}{dt} \left(\frac{1}{\tau} \int_{t_0}^{t_1} U_E \, dt + U_{A0} \right) = \frac{1}{R} \int_{t_0}^{t_1} U_E \, dt + U_{A0}$
\$\;\$ \$\;\$	$U_A = -\frac{1}{\tau} \int_{t_0}^{t_1} U_E \, dt + U_{A0}$
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Last update: **2022/01/10 00:01**

