

rechnung_betragundphase_umkehrintegrator

Student Group

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\$\;\$ \$\;\$ \$\;\$	$U_O = -\{1 \over {R \cdot C}\} \cdot \int_{t_0}^{t_1} U_I(t) \, dt + U_{A0}$
\$\;\$ \$\;\$ \$\;\$	insert sine function: $U_I(t) = \hat{U}_I \cdot \sin(\omega \cdot t)$
\$\;\$ \$\;\$ \$\;\$	$U_O = -\{1 \over {R \cdot C}\} \cdot \int_{t_0}^{t_1} \hat{U}_I \cdot \sin(\omega \cdot t) \, dt + U_{A0}$
\$\;\$ \$\;\$ \$\;\$	insert root function with limits $\int_{x_0}^{x_1} \sin(a \cdot x) \, dx = [-\{1 \over a\} \cdot \cos(a \cdot x)]_{x_0}^{x_1}$
\$\;\$ \$\;\$ \$\;\$	$U_O = -\{1 \over {R \cdot C}\} \cdot [-\hat{U}_I \over \omega \cdot \cos(\omega \cdot t)]_{t_0}^{t_1} + U_{A0}$
\$\;\$ \$\;\$ \$\;\$	put constant before integral
\$\;\$ \$\;\$ \$\;\$	$U_O = \{1 \over {R \cdot C}\} \cdot \hat{U}_I \over \omega \cdot [\cos(\omega \cdot t)]_{t_0}^{t_1} + U_{A0}$
\$\;\$ \$\;\$ \$\;\$	insert limits: $t_0=0$, $t_1=t$
\$\;\$ \$\;\$ \$\;\$	$U_O = \{\hat{U}_I \over {\omega \cdot R \cdot C}\} \cdot (\cos(\omega \cdot t) - \cos(0)) + U_{A0}$
\$\;\$ \$\;\$ \$\;\$	$\cos(0) = 1$
\$\;\$ \$\;\$ \$\;\$	$U_O = \{\hat{U}_I \over {\omega \cdot R \cdot C}\} \cdot (\cos(\omega \cdot t) - 1) + U_{A0}$
\$\;\$ \$\;\$ \$\;\$	multiply
\$\;\$ \$\;\$ \$\;\$	$U_O = \{\hat{U}_I \over {\omega \cdot R \cdot C}\} \cdot \cos(\omega \cdot t) \cdot \{-\hat{U}_I \over {\omega \cdot R \cdot C}\} + U_{A0}$
\$\;\$ \$\;\$ \$\;\$	consider the non-cosine terms: The blue part is independent in time. We assume purely sinusoidal quantities!
\$\;\$ \$\;\$ \$\;\$	$U_O = \{\hat{U}_I \over {\omega \cdot R \cdot C}\} \cdot \cos(\omega \cdot t) \cdot \{-\hat{U}_I \over {\omega \cdot R \cdot C}\} + U_{A0}$
\$\;\$ \$\;\$ \$\;\$	\rightarrow initial voltage of the capacitor: $U_{C0} = U_{A0} = \hat{U}_I \over {\omega \cdot R \cdot C}$
\$\;\$ \$\;\$ \$\;\$	$U_O = \{\hat{U}_I \over {\omega \cdot R \cdot C}\} \cdot \cos(\omega \cdot t)$
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