

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
\$\;\$ \$\;\$ \$\;\$	$U_O = \{ 1 \over {R \cdot C} \} \cdot \{ \hat{U}_I \over \omega \} \cdot \int_{t_0}^{t_1} [\cos(\omega \cdot t)]_{t_0}^{t_1} + U_{A0}$
\$\;\$ \$\;\$ \$\;\$	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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Last update: **2023/01/31 18:37**

