rechnung_betragundphase_umkehrintegrator

Student Group

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$\;$ $\;$ $\;$	$U_{\rm O} = -{ 1 \over {R\cdot C} }\cdot\int_{t_0}^{t_1} \color{blue}{U_{\rm I}(t)} \ {\rm d}t + U_{\rm O0}$
$\;$ $\;$ $\;$	insert sine function: $ \color{blue}{U_{\rm I}(t)}= \hat{U}_{\rm I} \cdot \sin(\omega \cdot t)$
	$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$
$\;$ $\;$ $\;$	$U_{\rm O} = -{ 1 \over {R\cdot C} }\cdot\color{blue}{\int_{t_0}^{t_1} \hat{U}_{\rm I} \cdot \sin(\omega \cdot t) \ {\rm d}t} + U_{\rm O0}$
$\;$ $\;$ $\;$	insert root function with limits $\color{blue}{\int_{x_0}^{x_1} \sin(a \cdot x) \ {\rm d}x} = [- {1 \over a} \cdot \cos(a \cdot x)]_{x_0}^{x_1}$
	$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$
$\;$ $\;$ $\;$	$U_{\rm O} = -{ 1 \over {R\cdot C} }\cdot [- \color{blue}{\hat{U}_{\rm I} \over \omega} \cdot \cos(\omega \cdot t)]_{t_0}^{t_1} + U_{\rm O0}$
$\;$ $\;$ $\;$	put constant before integral
	$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$
$\;$ $\;$ $\;$	$U_{\rm O} = { 1 \over {R\cdot C} }\cdot {\hat{U}_{\rm I} \over \omega} \cdot \color{blue}{[\cos(\omega \cdot t)]_{t_0}^{t_1}} + U_{\rm O0}$
$\;$ $\;$ $\;$	insert limits: $t_0=0$, $t_1=t$
	$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$
$\;$ $\;$ $\;$	$U_{\rm O} = {{{\hat{U}_{\rm I} } \over {\omega \cdot R\cdot C} } \cdot (} \cos(\omega \cdot t) - \color{blue}{\cos(0)}) + U_{\rm O0}$
$\;$ $\;$ $\;$	$\color{blue}{\cos(0)}=1$
	$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$
$\;$ $\;$ $\;$	$U_{\rm O} = \color{blue}{{{{ \hat{U}_{\rm I} } \over {\omega \cdot R\cdot C} } \cdot (} \cos(\omega \cdot t) - 1 \color{blue}{)} + U_{\rm O0}$
$\;$ $\;$ $\;$	multiply
	$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$
$\;$ $\;$ $\;$	$U_{\rm O} = { {\hat{U}_{\rm I} } \over {\omega \cdot R\cdot C} } \cdot \cos(\omega \cdot t) \color{blue}{-{ {\hat{U}_{\rm I} } \over {\omega \cdot R\cdot C}} + U_{\rm O0}}$
$\;$ $\;$ $\;$	consider the non-cosine terms: The blue part is independent in time. We assume purely sinusoidal quantities!
	$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$
$\;$ $\;$ $\;$	$U_{\rm O} = { {\hat{U}_{\rm I} } \over {\omega \cdot R\cdot C} } \cdot \cos(\omega \cdot t) \color{blue}{-{ {\hat{U}_{\rm I} } \over {\omega \cdot R\cdot C}} + U_{\rm O0}}$
$\;$ $\;$ $\;$	$\rightarrow$ initial voltage of the capacitor: $U_{C0} = U_{\rm O0}={{\hat{U}_{\rm I}} \over {\omega \cdot R\cdot C}}$
	$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$
$\;$ $\;$ $\;$	$U_{\rm O} = { {\hat{U}_{\rm I} } \over {\omega \cdot R\cdot C} } \cdot \cos(\omega \cdot t)$
$\;$ $\;$ $\;$	
	$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$