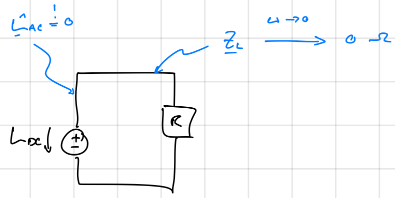
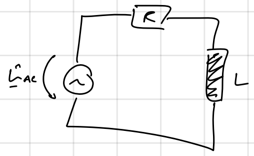
MLSZ_WOJ : Bsp1

a) $I_{DC} = \frac{U_{DC}}{R} = \frac{5V}{20\Omega} = \underline{\underline{0.25A}}$ $\rightsquigarrow$



b)



$\Longrightarrow \underline{\hat{u}}_{AC} = \hat{u}_{AC} \cdot e^{j\cdot\frac{\pi}{2}}$

$\Longrightarrow \underline{Z} = R + j\omega L$

$\Longrightarrow \underline{\hat{i}}_{AC} = \frac{\underline{\hat{u}}_{AC}}{\underline{Z}} = \frac{\hat{u}_{AC}\, e^{-j\cdot\frac{\pi}{2}}}{R + j\omega L}$

$$\underline{\hat{i}}_{AC} = \frac{\hat{u}_{AC}\, e^{-j\cdot\frac{\pi}{2}}}{R + j\omega L} = \frac{\hat{u}_{AC}\, e^{-j\cdot\frac{\pi}{2}}}{\sqrt{R^2 + (\omega L)^2}\cdot e^{j\cdot \mathrm{atan}\left(\frac{\omega L}{R}\right)}} = \frac{\hat{u}_{AC}\cdot e^{j\left[-\frac{\pi}{2} - \mathrm{atan}\left(\frac{\omega L}{R}\right)\right]}}{\sqrt{R^2 + (\omega L)^2}}$$

$$\Longrightarrow i_{AC}(t) = \frac{\hat{u}_{AC}}{\sqrt{R^2 + (\omega L)^2}} \cdot \cos\left[\omega t - \frac{\pi}{2} - \mathrm{atan}\left(\frac{\omega L}{R}\right)\right] = 0.452\,A \cdot \sin(\omega t - 25.23^\circ)$$

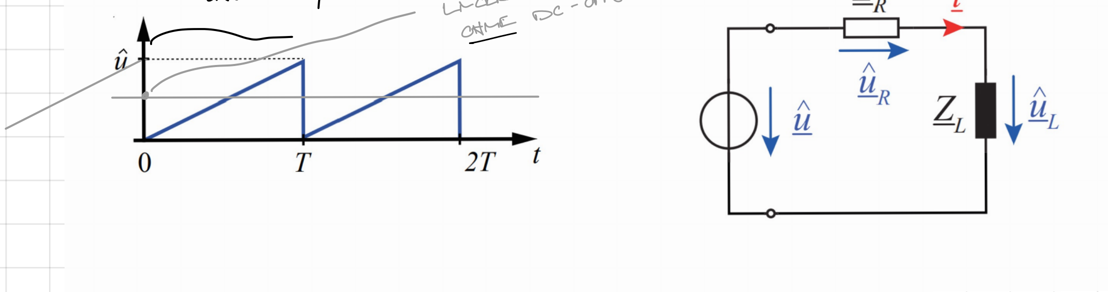
c) $$\Longrightarrow i(t) = i_{DC}(t) + i_{AC}(t) = 0.25 + \frac{\hat{u}_{AC}}{\sqrt{R^2 + (\omega L)^2}} \cdot \cos\left[\omega t - \frac{\pi}{2} - \mathrm{atan}\left(\frac{\omega L}{R}\right)\right]$$

MLSZ_WO9 : BSP 2

$a_n = 0 \quad \forall n \geq 1$

$a_0 \neq 0 \iff$ WIR HABEN DA EBEN EINEN DC-OFFSET...

a)



$u(t) = t\,\frac{\hat{u}}{T}$

WÄRE EINE UNGERADE FUNKTION OHNE DC-OFFSET

SCHRITT 1 : SYMMETRIEN ABSCHÄTZEN !!

$\rightsquigarrow a_n = 0 \quad \forall n \geq 1$

$$\rightsquigarrow a_0 = \frac{1}{T}\int_0^T u(t)\,dt = \frac{1}{T}\int_0^T t\,\frac{\hat{u}}{T}\,dt = \frac{\hat{u}}{T^2}\left[\frac{t^2}{2}\right]_0^T = \frac{\hat{u}}{2}$$

$$\rightsquigarrow b_n = \frac{2}{T}\int_0^T u(t)\sin\Big(\underbrace{\tfrac{2\pi n}{T}}_{=\omega}t\Big)\,dt = \underbrace{\frac{2\hat{u}}{T^2}\int_0^T \underbrace{t}_{:=g}\underbrace{\sin\left(\tfrac{2\pi n}{T}t\right)}_{:=f'}dt}_{\rightsquigarrow \text{ PARTIELL INTEGRIEREN...}} = \frac{2\hat{u}}{T^2}\left(\left[\frac{-T}{2\pi n}\,t\cos\left(\frac{2\pi n}{T}t\right)\right]_0^T + \underbrace{\int_0^T \frac{T}{2\pi n}\cos\left(\frac{2\pi n}{T}t\right)dt}_{0}\right) = \frac{2\hat{u}}{\cancel{T^2}}\,\frac{-\cancel{T^2}}{2\pi n}$$

$$= \frac{-\hat{u}}{\pi\cdot n}$$

$\Longrightarrow$ IN FORMEL EINSETZEN : (WOS_SLIDES-p.6)

$$u(t) = \frac{\hat{u}}{2} + \sum_{n=1}^{\infty}\frac{-\hat{u}}{\pi n}\sin(n\omega t)$$

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b)

DC-TEIL : $I_{DC} = \frac{\frac{\hat{u}}{2}}{R} = \frac{\hat{u}}{2R}$

AC-TEIL : n-te SPANNUNGSQUELLE : $u_n(t) = \frac{-\hat{u}}{n\pi}\cdot\cos\left(n\omega t - \frac{\pi}{2}\right)$

ROT. ZEIGER $\rightarrow \hat{u}_n = \frac{-\hat{u}}{n\pi}\,e^{-j\frac{\pi}{2}}$

IMPEDANZ IST AUCH FREQUENZABHÄNGIG

$\rightsquigarrow Z = R + j\,n\cdot\omega\cdot L$

$$\longrightarrow \hat{i}_n = \frac{\hat{u}_n}{Z} = \frac{\frac{-\hat{u}}{n\pi}e^{-j\frac{\pi}{2}}}{R + jn\omega L} = \frac{-\hat{u}}{n\pi\cdot\sqrt{R^2 + (n\omega L)^2}}\cdot e^{j\left[-\frac{\pi}{2} - \arctan\left(\frac{n\omega L}{R}\right)\right]}$$

ZEITBEREICH : $i_n(t) = \frac{-\hat{u}}{n\pi\cdot\sqrt{R^2 + (n\omega L)^2}}\cdot\cos\left[n\omega t - \frac{\pi}{2} - \arctan\left(\frac{n\omega L}{R}\right)\right]$

$\rightsquigarrow$ ZUSAMMENSETZEN : $i(t) = I_{DC} + \sum_{n=1} i_n(t)$