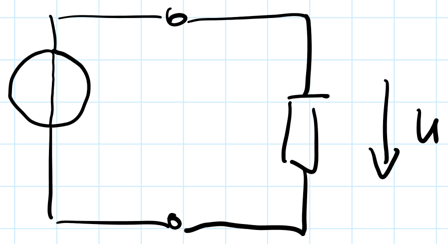
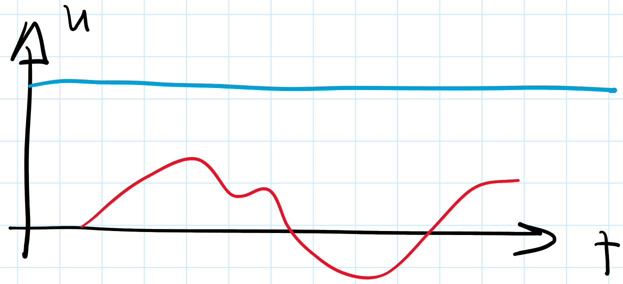
GLET1 / Zeitabhängigkeit

Freitag, 17. November 2023 19:53

68 – 86 – 17 – 50



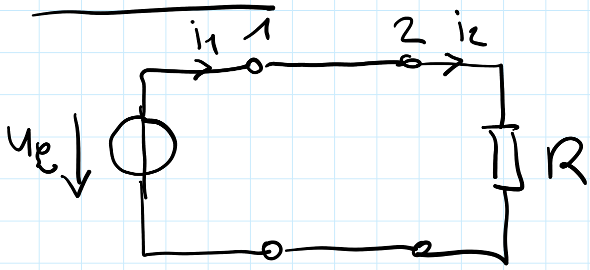


NOTATION

U, I, P DC direct current

$u, i, U(t)$ AC alternating current

ZWEIPOL



DC $u_q = \text{const.}$ $i_1 = i_2$

AC Ausbreitung der Felder

$v \leq c_0 \Rightarrow i_1 \neq i_2$

$$\lambda = \frac{c}{f}$$

50 Hz $\Rightarrow \lambda = 5.995{,}849$ km

2,4 GHz $\Rightarrow \lambda = 12{,}491$ cm

$\Rightarrow$ QUASISTATIONÄR: GEOMETRIE $\ll \lambda$

KLASSIFIZIERUNG

ANALOG – DIGITAL

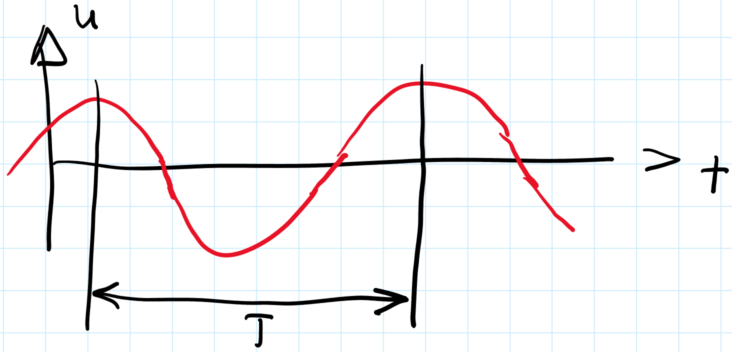
DETERMINISTISCH – STOCHASTISCH

DETERMINISTISCH – STOCHASTISCH

EIN – MEHRDIMENSIONAL

KONSTANT – QUASISTATIONÄR – INSTATIONÄR

SIGNAL PERIODISCH



$u(t) = u(t + nT)$

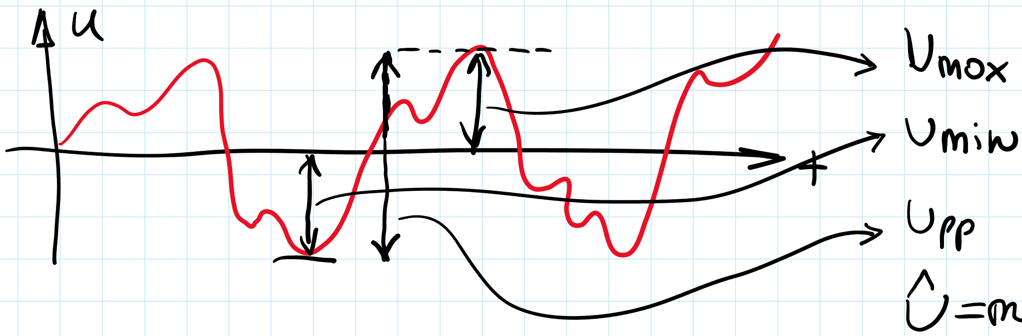
$n = 0, 1, 2, 3 \ldots$

T… Periodendauer

$[T] = s$

Frequenz $f = \frac{1}{T}$ $\quad [f] = 1\ Hz = \frac{1}{s}$

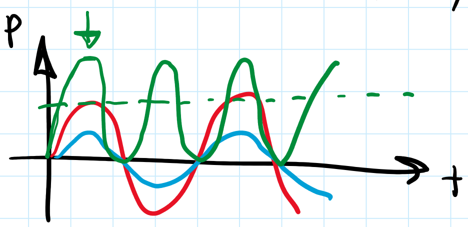
Kreisfrequenz ω $\quad \omega = 2\pi f$ $\quad [\omega] = 1/s$



$\hat{U} = max(U_{max}, U_{min})$

GLEICHWERT

$$\bar{u} = \frac{1}{T}\int_{t_0}^{t_0+T} u\, dt$$



EFFEKTIVWERT (RMS)

$$P(t) = R i^2$$

$$dW = P(t) \cdot dt = R i dt$$

$$W_T = \int_0^T dW dt = R \int_0^T i^2 dt$$

$I \rightarrow DC$

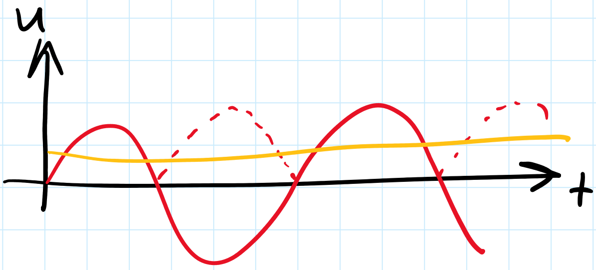
$$W_T = \int_0 dW\,dt = R \int_0 i^2\,dt \qquad I \rightarrow DC$$

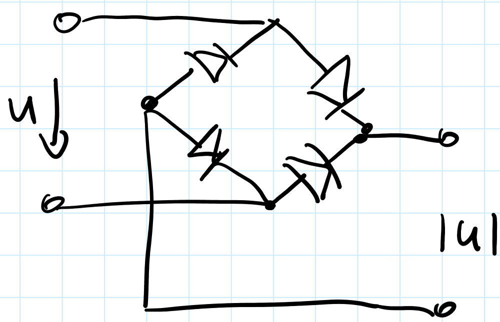
$$\cancel{R}\, I^2 \cdot T = \cancel{R} \int_0^T i^2\,dt$$

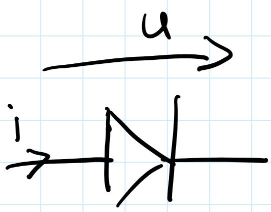
$$I = \sqrt{\frac{1}{T}\int_0^T i^2\,dt}$$

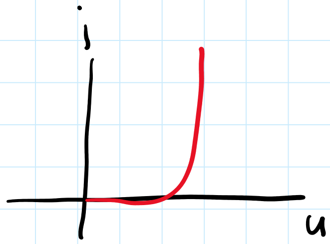
GLEICHRICHTWERT

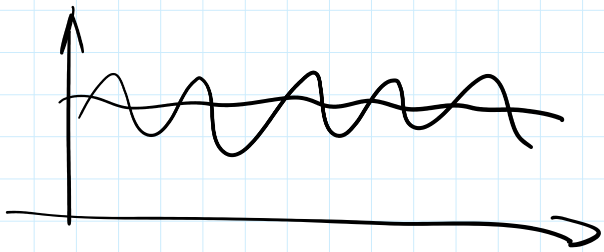
$$|\bar{u}| = \frac{1}{T}\int_0^T |u|\,dt$$











$\boxed{\text{E10}}$

$f = 111\ Hz$

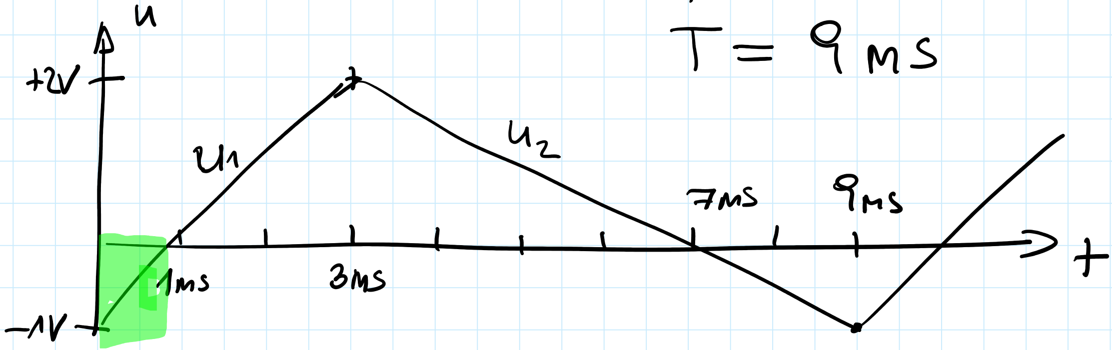
$T = 9\ ms$

$U_{min} = -1V$

$U_{max} = +2V$

$U_{pp} = 3V$

$\hat{U} = +2V$



$$u_1 = k_1 t + d_1$$

$$u_1(0) = -1 \Rightarrow k_1 \cdot 0 + d_1 \Rightarrow d_1 = -1$$

$$u_1(3ms) = 2 = k_1 \cdot 3ms + d_1$$

$u_1 = k_1 t + d_1$

$u_1(0) = -1 \Rightarrow k_1 \cdot 0 + d_1 \Rightarrow d_1 = -1$

$u_1(3ms) = 2 = k_1 \cdot 3ms + d_1$

$k_1 = 1000\,V/s$

$$u_1 = \frac{1000\,V}{s} t + -1V$$

$u_2 = k_2 \cdot t + d_2$

$u_2(3ms) = 2V \Rightarrow k_2 \cdot \frac{3}{1000} + d_2 = 2$

$u_2(9ms) = -1V \Rightarrow k_2 \frac{9}{1000} + d_2 = -1$

$k_2 = -500\,V/s \qquad d_2 = 3{,}5\,V$

$$u_2 = -500 \frac{V}{s} t + 3{,}5\,V$$

$$\bar{u} = \frac{1000}{9\,s}\left(-1V \cdot \frac{1}{1000} s \cdot \frac{1}{2} + 2V \cdot \frac{2}{1000} s \frac{1}{2} + 2V \frac{4}{1000} s \frac{1}{2} - 1V \frac{2}{1000} s \cdot \frac{1}{2}\right) =$$

$$= \frac{1}{2} V$$

$$U^2 = \frac{1}{T}\left(\int_0^{3/1000\,s} u_1^2\,dt + \int_{3/1000\,s}^{9/1000\,s} u_2^2\,dt\right) =$$

$u_1^2 = 1e6\,t^2 - 2000t + 1$

$u_2^2 = 250.000\,t^2 - 3500t + \frac{49}{4}$

$$\int_0^{3/1000\,s} (1e6\,t^2 - 2000t + 1)\,dt = \left[\frac{1e6}{3} t^3 - 1000t^2 + t\right]_0^{3/1000} =$$

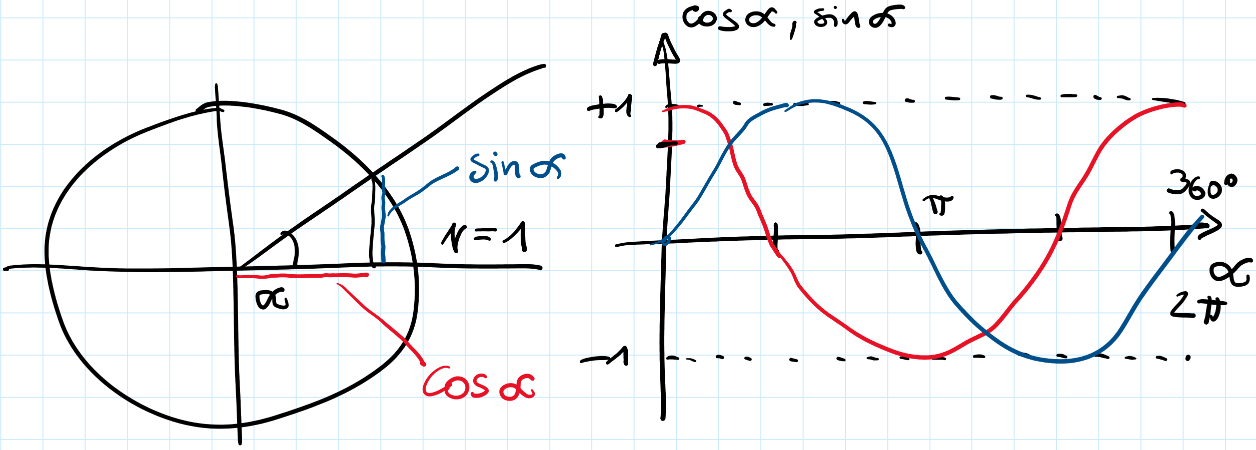
$$= \frac{9}{1000} - \frac{9}{1000} + \frac{3}{1000} = \frac{3}{1000}$$

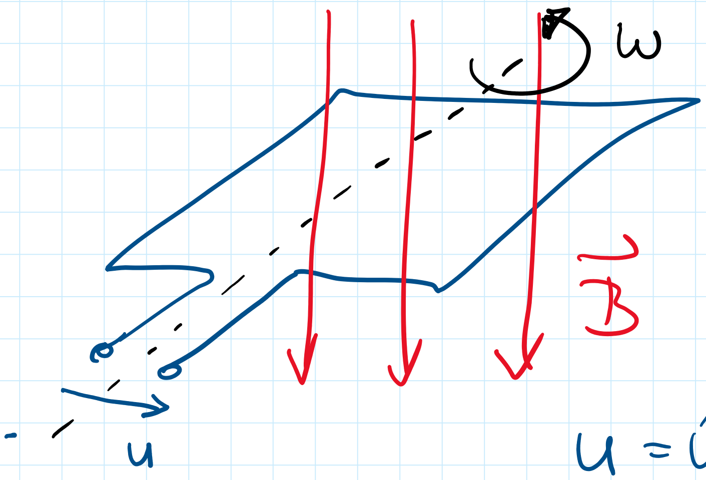
$$\int_{3/1000}^{9/1000} \left(250.000\,t^2 - 3.500t + \frac{49}{4}\right) dt = \left[\frac{250000}{3} t^3 - \frac{3500}{2} t^2 + \frac{49}{4} t\right]_{3/1000}^{9/1000} =$$

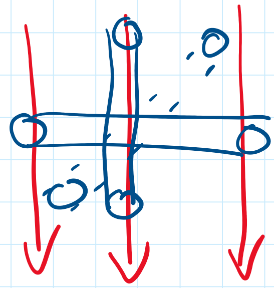
$$= \frac{6}{1000}$$

$$U^2 = \frac{1000}{9}\left(\frac{3}{1000} + \frac{6}{1000}\right) V^2 = 1\,V^2 \Rightarrow U = \sqrt{1V^2} = 1V$$

$$U^2 = \frac{1000}{9}\left(\frac{3}{1000}+\frac{6}{1000}\right)V^2 = 1\,V^2 \Rightarrow U = \sqrt{1\,V^2} = 1\,V$$







$$u = \hat{u}\cos(\omega t + \varphi)$$