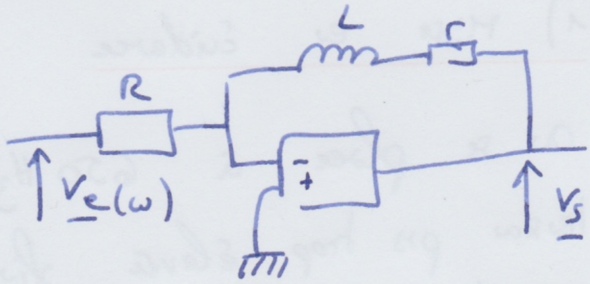
Induction - autoinduction

I. Inductance d'une bobine

- Bobine classique de TP (Ex 250 ou 500 spire) Leybold
- Résistance (~ 1k Ω)
- Ampli op
- Multimètre, GBF

Montage impédance mètre :



$V^- = V^+ = 0$ AOP idéal

$$V^- = \frac{\frac{V_e}{R} + \frac{V_s}{jL\omega + r}}{\frac{1}{R} + \frac{1}{jL\omega + r}}$$

En RMS : $\left(\frac{V_s}{V_e}\right)^2 = \left(\frac{L}{R}\omega\right)^2 + \left(\frac{r}{R}\right)^2$

On peut tracer $V_s^2 = f(\omega^2)$

Sinon

Classique $\left(\frac{U_{eff}}{I_{eff}}\right)^2 = R^2 + L^2\omega^2$

100.1

Inductance dans une bobine

Calculs:

$$0 = \frac{V_e}{R} + \frac{V_s}{j\omega L + r} \Rightarrow \frac{V_e}{R} = \frac{-V_s}{j\omega L + r} \Rightarrow \frac{V_s}{V_e} = -\frac{j\omega L + r}{R}$$

$$\Rightarrow \frac{V_s}{V_e} = \frac{-j\omega L}{R} - \frac{r}{R}$$

tension efficace:

$$U = \sqrt{\frac{1}{T}\int_{t_0}^{t_0+T} u^2(t)\,dt}$$

Or

$$V_e = v_e \cos(\omega t + \varphi_e) \rightarrow \underline{V_e} = v_e e^{j(\omega t+\varphi)} \quad ; V_e = Re(\underline{V_e}) \quad ; V_e^{RMS} = \frac{v_e}{\sqrt{2}}$$

$$V_s^{RMS} = \sqrt{\frac{1}{T}\int_{t_0}^{t_0+T} Re(\underline{V_s})^2\,dt} = \frac{1}{T}\int_{t_0}^{t_0+T}$$

$$\underline{V_s} = -\frac{r}{R} v_e e^{j(\omega t+\varphi)} - \frac{j\omega L}{R} v_e\left(\cos(\omega t+\varphi) + j\sin(\omega t+\varphi)\right)$$

$$= \underbrace{\left(-\frac{r}{R} v_e \cos(\omega t+\varphi) + \frac{\omega L}{R} v_e \sin(\omega t+\varphi)\right)}_{Re(\underline{V_s})} + j(\text{—})$$

$$\Rightarrow \int_{t_0}^{t_0+T} \left(\frac{r}{R}v_e\right)^2 \underbrace{\cos^2(\omega t+\varphi)}_{T/2} + \left(\frac{\omega L}{R}v_e\right)^2 \underbrace{\sin^2(\omega t+\varphi)}_{T/2} + \underbrace{\frac{r}{R}\frac{\omega L}{R} v_e^2 \cos(-)\sin(-)\,dt}_{=0}$$

$$\Rightarrow V_s^{RMS} = \sqrt{\frac{1}{2}\left(\left(\frac{r\,v_e}{R}\right)^2 + \left(\frac{\omega L}{R}v_e\right)^2\right)}$$

D'où $\boxed{\left(\frac{V_s^{RMS}}{V_e^{RMS}}\right)^2 = \left(\frac{r}{R}\right)^2 + \left(\frac{\omega L}{R}\right)^2}$