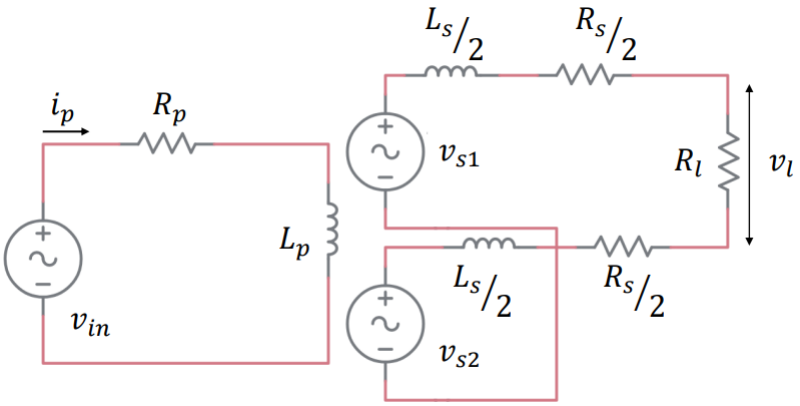
Question 2



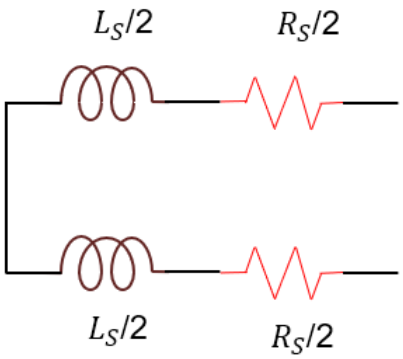
Given the LVDT, the output $v_o(t)$ and input $v_p(t)$ voltages are given by:

$$v_o(t) = k.x.\sin(\omega_p t + \phi)$$

$$v_p(t) = \sin(\omega_p t)$$

And $L_p = 4mH, L_s = 2mH, R_p = 100\Omega, R_s = 50\Omega$ find the output impedance and the frequency ω_p at which $\phi < 0.1\pi$

To find the output impedance, we have to short the voltage sources and open the load resistance



Output impedance is given by:

$$\mathcal{Z} = \sqrt{R_s^2 + X_L^2}$$

$$\mathcal{Z} = \sqrt{R_s^2 + (j\omega L_s)^2}$$

$$\mathcal{Z} = \sqrt{R_s^2 - \omega^2 L_s^2}$$

Therefore:

$$\phi = \tan^{-1} \frac{R_s}{\omega L_s}$$

Since we know that $\phi < 0.1\pi$, we can solve for ω_p:

$$\omega_p < \frac{R_s}{L_s} \tan(0.1\pi)$$

$$\omega_p < 8122.99\, rad/s$$