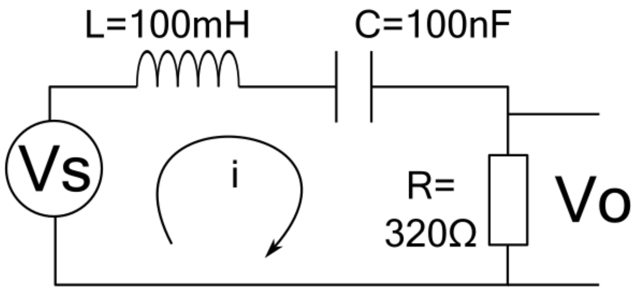
Exercise 1 (s domain)

Considering the following series RLC circuit.



V_s is the source voltage (input). V_o is the output voltage on the resistor. i is the current.

$$V_s = Ri + L\frac{di}{dt} + \frac{1}{C}\int i\,dt$$

$$\frac{i}{V_s} = \frac{1}{R + sL + (sC)^{-1}}$$

1. Derive the actual transfer function: $H(s) = \frac{V_o}{V_s}$
2. Assuming that V_s is an impulse $V_s = \delta(0)$, can you plot $V_o(t)$ time response.

Exercise 2 (z-transformation)

Consider the following sequence: (Common z transform ZT7)

$$y(n) = cos(\omega_0 nT)$$

The signal is to be converted into the z-domain as follows:

1. z-transform the sequence $y(n)$. Hint: Use Euler's identity ($\cos(x) = \frac{e^{ix} + e^{-ix}}{2}$).
2. Draw a pole-zero plot for $Y(z)$ (Use $\omega_0 T = 1$).
3. Draw a Bode plot for $Y(z)$.

Exercise 2 (Inverse z-transformation)

Consider the following difference equation:

$$y(n) - \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = -x(n-1) + 5x(n-2)$$

The sampling rate is 1 Hz. The output response $y(n)$ is to be determined when $x(n)$ is a unit step sequence through the following steps:

1. Derive the transfer function $H(z)$ of the system (Matlab function 'tf()')

2. Set up an expression for $Y(z) = H(z)X(z)$ when $x(n)$ is a **unit step sequence**. (matlab function 'step()')
3. Inversely z-transform $Y(z)$ and plot the output response $y(n)$.