Problem 1: Consider the RC circuit shown below.

A. Find $v_{out}(t)$ when $v_{in} = V \sin \omega t$. Assume the system is in sinusoidal steady state (i.e., all transients have disappeared).

B. Assume an input $v_{in} = V \sin(\omega t) u(t)$ so that the circuit is initially at rest. Find an expression for $v_{out}(t)$ when $t > 0$. **Hint: The solution for the previous part is needed here.**

C. Plot the solution assuming $V = 1$, $\omega = 1$, and $RC = 1$ as well as $V = 1$, $\omega = 10$, and $RC = 1$.

Problem 2: Consider the RLC circuit shown below.

A. Find a differential equation that relates $v_{in}$ and $v_{out}$.

B. Derive an expression for the transfer function from $v_{in}$ to $v_{out}$.

C. Sketch the Bode plot for the transfer function from $v_{in}$ to $v_{out}$ using asymptotic approximations.