# ECE451/551

## Homework 1

**Question 1.** Write the state equations for the circuit of Figure 1. Use the state vector given by $x = \begin{bmatrix} v \\ i \end{bmatrix}$.
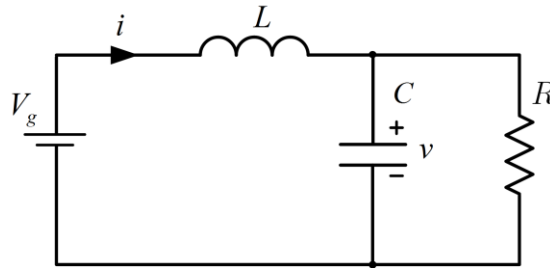
The output is the voltage across the resistor, i.e. $v$.



**Figure 1.** LCR network

**Question 2.**

a) Derive the transfer function $\dfrac{v(s)}{v_g(s)}$ using the impedance divider rule. That is, simplify the

following: $\dfrac{v(s)}{v_g(s)} = \dfrac{R \,||\, \dfrac{1}{sC}}{sL + R \,||\, \dfrac{1}{sC}}$.

b) Using your transfer function obtained in (a), write a state space representation in *phase variable* form.

c) Using your transfer function obtained in (a), write a state space representation in *dual phase variable* form.


**Question 3.** Confirm that your four representations of the LCR network system obtained in questions 1 and 2 are equivalent by plotting the Bode response using the Matlab function *bode*. Use component values, $L = 560 \ \mu H$, $C = 100 \ \mu F$ and $R = 5 \ \Omega$.