Name: _____

Collaborators: _____

Honor Pledge: *I have neither given nor received unauthorized assistance on this assignment. I attest that these solutions are my own.*

Signature: _____

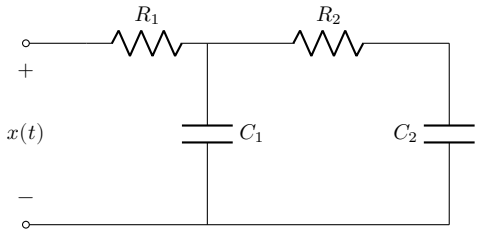
Instructions

Your solutions should begin with your name and the name of any collaborators. Each problem solution should include:

- the problem restated
- the final answer boxed, and
- the detailed derivation of your answer (text and equations).

Questions requiring computations or plots should generally include the code you wrote as well as the result. Your exercise solutions must be submitted via Canvas by 11:59 pm on the due date as a single .pdf file with all pages oriented in the same direction. You should either typeset your solutions, use a PDF annotating tool, or scan work done with pencil and paper (the free Adobe Scan app works well). You can insert pages if needed but maintain the question ordering. Illegible submissions will not be considered.

1. Given the following circuit,



derive the state-space description in the form

$$\dot{q} = Aq + Bx$$

where q is the state vector.

Solution:

2. Given the transfer function

$$H(s) = \frac{100}{(s+5)\,(s^2+2s+7)}\ ,$$

derive the state-space description in the form

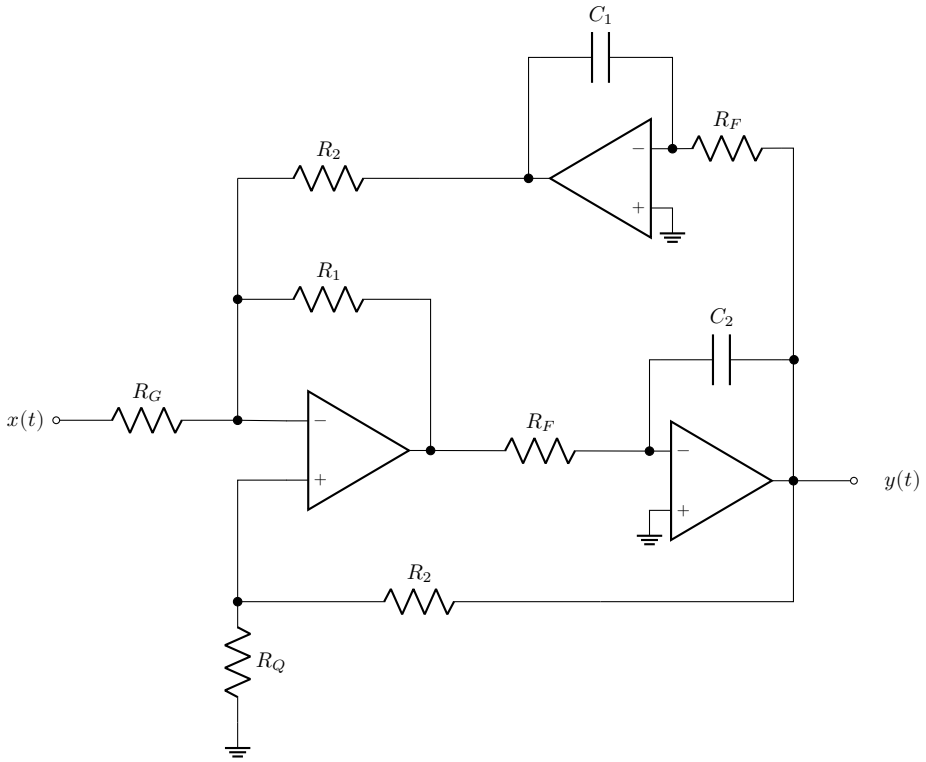
$$\dot{q} = Aq + Bx$$

$$y = Cq + Dx$$

where q is the state vector, x is the input, and y the output.

Solution:

3. Consider the circuit from Lab 1



Derive the state-space description in the form

$$\dot{q} = Aq + Bx$$

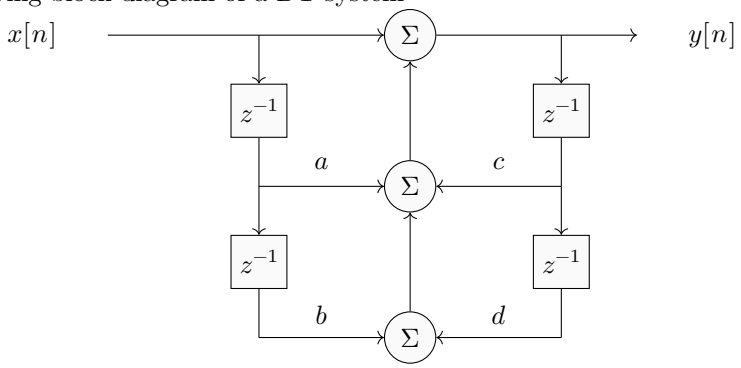
$$y = Cq + Dx$$

where q is the state vector, x is the input, and y the output. Then convert that description to the transfer function $H(s)$.

Solution:

3. (cont)

4. Given the following block diagram of a DT system



derive the state space description in the form

$$q[n+1] = Aq[n] + Bx[n]$$

$$y[n] = Cq[n] + Dx[n]$$

Solution:

5. For the circuit in problem 1 where $R_1 = 100\,\text{k}\Omega$, $R_2 = 50\,\text{k}\Omega$, and $C_1 = C_2 = 1\,\mu\text{F}$, use the derived state-space desciption to simulate the system when the input is the expression

$$x(t) = \frac{te^{-t}}{2 + \cos(10t)}\,u(t)$$

using the Runge-Kutta integrator (in C/C++ as demonstrated in class, or using the ode45 command in Matlab) for 8 seconds, starting at $t = 0$. Plot the input and all state trajectories, overlayed on the same plot, or as separate subplots. Submit your code as a zip file.

Solution: