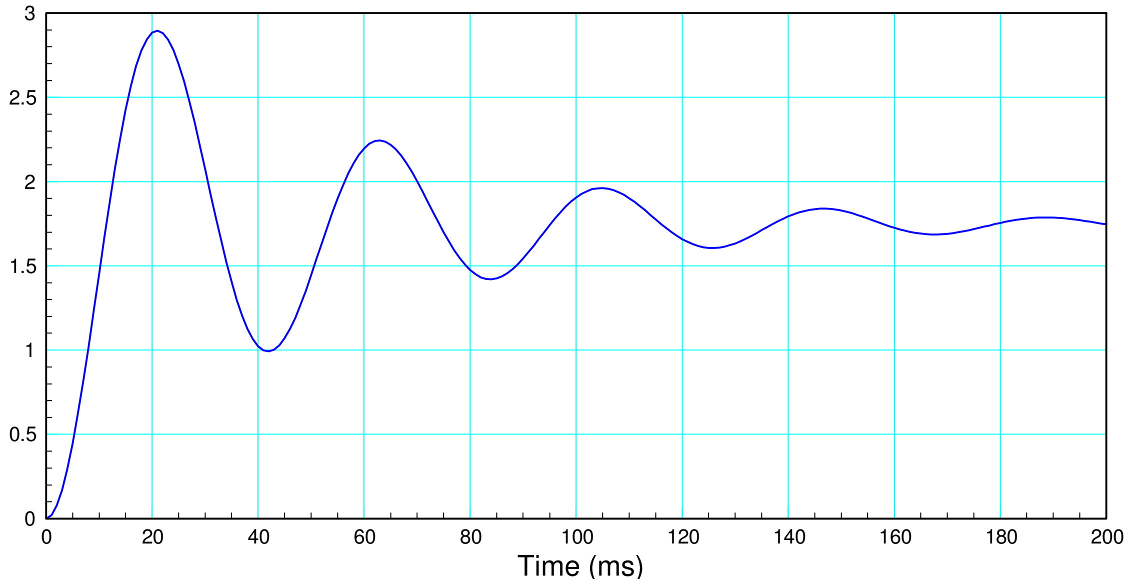
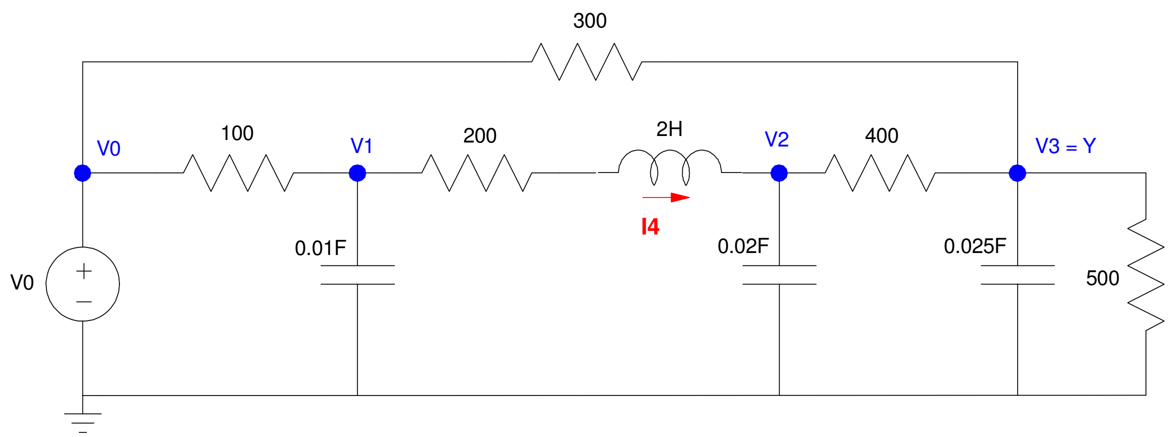
ECE 461 - Final: Name ______________________

Fall - 2022

1) Give the transfer function for a system with the following step response:



2) Write the differential equations which describe the following circuit (i.e. write the N differential equations which correspond to the voltage node equations)



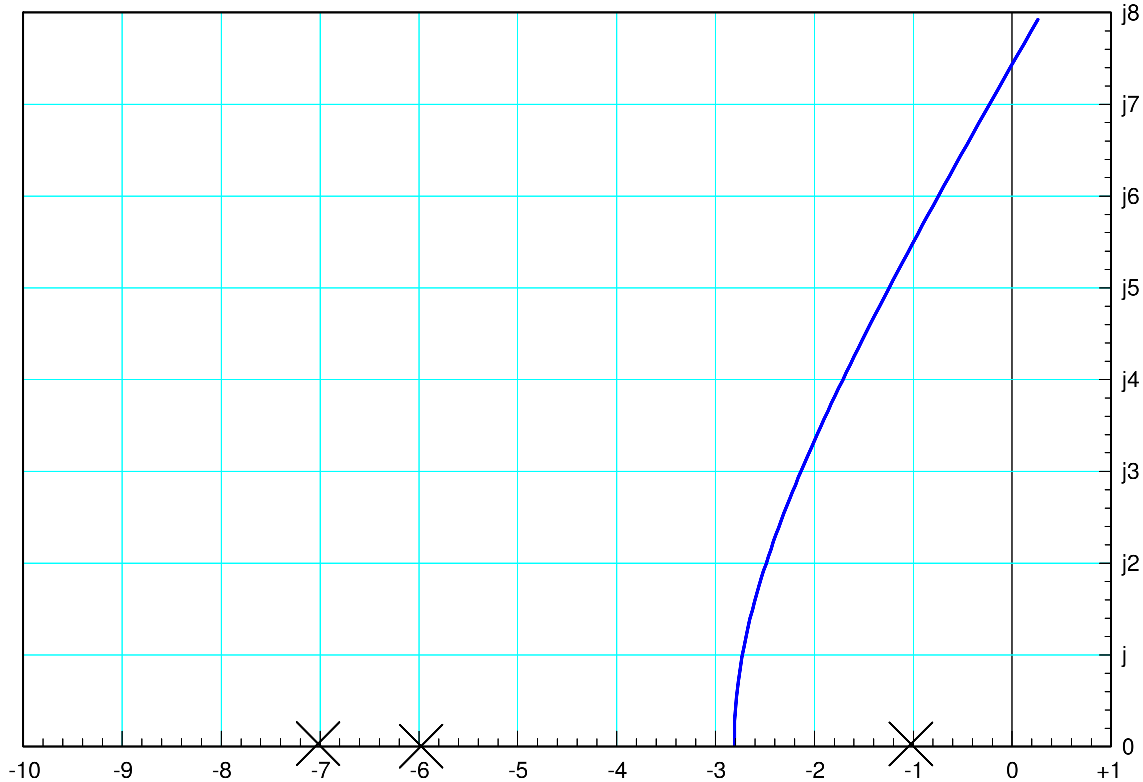
2b) Express these dynamics in state-space form

3) Gain Compensation: The root locus for

$$G(s) = \left(\frac{40}{(s+1)(s+6)(s+7)}\right)$$

is shown below. Determine the following:

Maximum gain, k, for a stable closed-loop system	
k for a damping ratio of 0.15	
Closed-loop dominant pole(s) for a damping ratio of 0.15	
Closed-Loop DC gain for a damping ratio of 0.15	



4) Given the following stable system

$$G(s) = \left(\frac{40}{(s+1)(s+6)(s+7)}\right)$$

Determine a compensator, K(s), which results in the closed-loop system having

- No error for a step input, and
- A closed-loop dominant pole at s = -3 + j2

5) Given the following stable system

$$G(z) = \left(\frac{0.04(z+1)}{(z-0.9)(z-0.4)(z-0.3)} \right)$$

Determine a digital compensator, K(z), which results in the closed-loop system having

- No error for a step input,
- A closed-loop dominant pole at $z = 0.7 + j0.1$, and
- A sampling rate of $T = 0.01$

6) Given the following stable system

$$G(s) = \left(\frac{40}{(s+1)(s+6)(s+7)}\right)$$

Determine a compensator, K(s), which results in the closed-loop system having

- A closed-loop DC gain of 1.000 (i.e. no error for a step input),
- A 0dB gain frequency of 3 rad/sec, and
- A phase margin of 55 degrees