ECE 207 **Lab Work 16 & 17** **Due November 11th**

Names ____

Objectives

Learn the value of feedback in control systems in two respects:

i) that feedback can make system performance robust with respect to changes in the forward path.

ii) that feedback can extend system bandwidth.

Deliverables

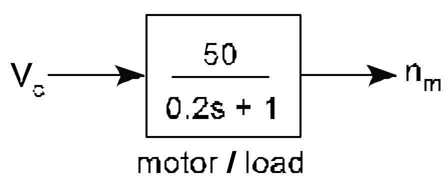
Completed procedure

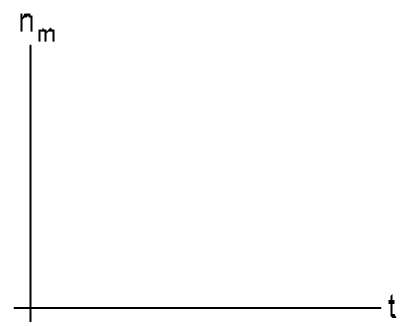
Pre-lab

Review the class notes on control systems and be sure that you understand the solution of all worked examples.

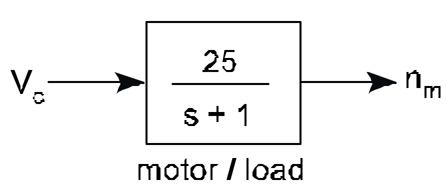
Procedure

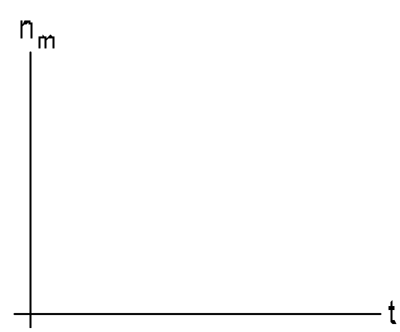
1. Use SIMULINK to simulate the DC motor model shown below. Apply a 40V step as the input and neatly sketch the response. Show the response from $0<t<5\tau$ and do not forget to label axes. *Save this model, you will use it again later.*





2. Use SIMULINK to simulate the DC motor model shown below. Apply a 40V step as the input and neatly sketch the response—use the same time scale as in #1.



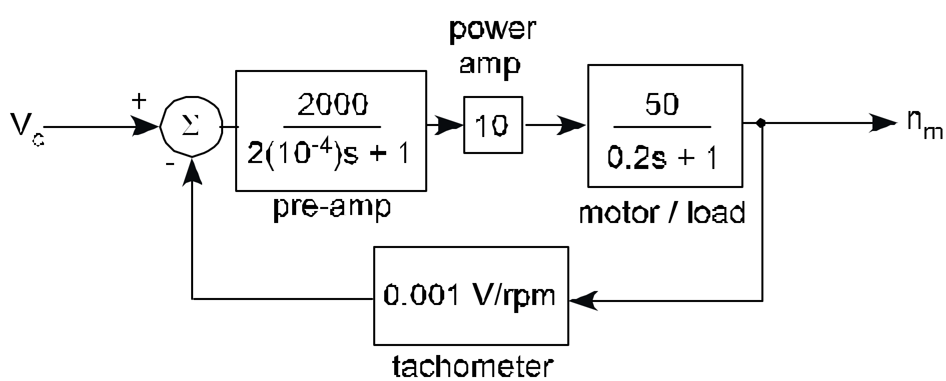


3. In #1 and #2, you investigated the system response for two open-loop control systems. What do you conclude about the robustness of this type of system with respect to changes in the DC motor characteristics (that is, is the input-output relationship insensitive to changes in the motor characteristics?).

   In an application requiring constant speed under different loads, is this a practical control scheme?

4. Use SIMULINK to simulate the DC motor model shown below. Apply a 2V step as the input.

   Set simulation time for 4ms and set max. step size in simulation to 0.00001. Attach a printout of the simulated response. *Save this model, you will use it again later.*

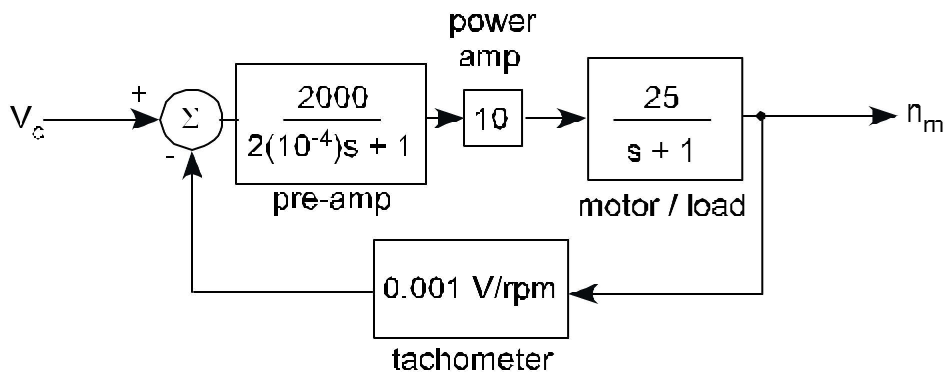


Complete the following table (use peak time for ω_d, %OS for ζ)

parameter	theoretical	simulated	% difference
K (static gain)			
ω_d			
ζ			
ω_n			

5. Use SIMULINK to simulate the DC motor model shown below. Apply a 2V step as the input.

   Leave the simulation time at 10ms and max. step size at 0.00001. Attach a printout of the simulated response.



   Complete the following table

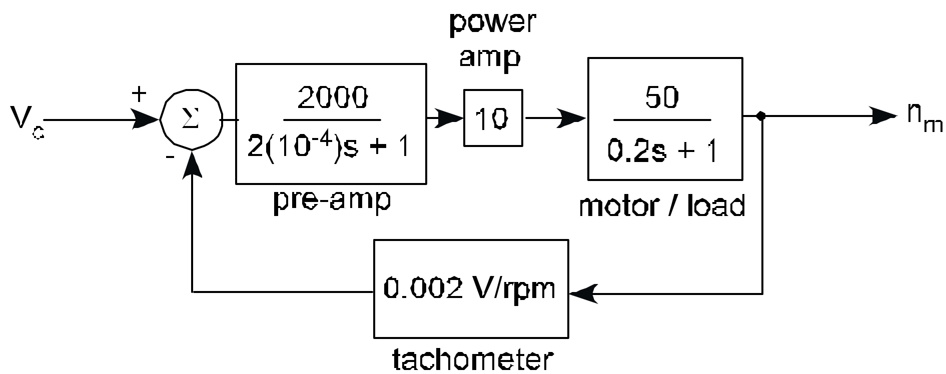
parameter	theoretical	simulated	% difference
K (static gain)			

6. In #4 and #5, you investigated the system response for two closed-loop control systems. What do you conclude about the robustness of the input voltage-output speed relationship for this system with respect to changes in the DC motor characteristics (that is, is the input voltage-output speed relationship insensitive to changes in the motor characteristics.)?

   If there are differences, what are they? Are they differences in the steady-state behavior or in the transient behavior? Which system would react more quickly to changes in the input? Is this system over or underdamped? Compare ζ to 1.

   In an application requiring constant speed under different loads, is this a practical control scheme?

7. Use SIMULINK to simulate the DC motor model shown below. Apply a 2V step as the input. Set simulation time for 4ms. Attach a printout of the simulated response.



parameter	theoretical	simulated	% difference
K (static gain)			
ω_d			
ζ			
ω_n			

8. Is a closed-loop control system robust with respect to the feedback measurement?

9. Use MATLAB to generate a Bode magnitude plot for the system in #1. *Attach a printout of the Bode plot.* Suppose the input were a sinusoid with an amplitude of 40V. What would the amplitude of the response be at the frequencies shown below?

   i) ω = 2 r/s

   ii) ω = 1000 r/s

10. Use MATLAB to develop a Bode magnitude plot for the system in #4. Suppose the input were a sinusoid with an amplitude of 2V. What would the amplitude of the response be at the frequencies shown below?

   i) ω = 2 r/s

   ii) ω = 1000 r/s

11. What conclusions can you draw about the effect of feedback on bandwidth?