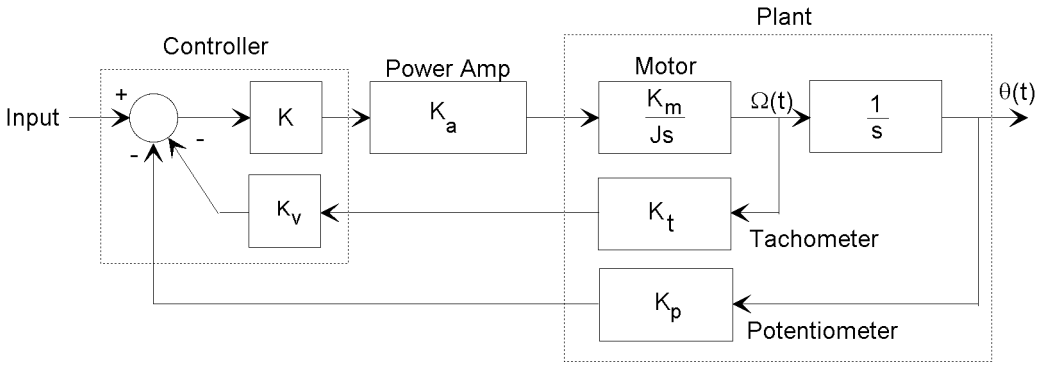
Department of Mechanical Engineering

2.010 CONTROL SYSTEM PRINCIPLES

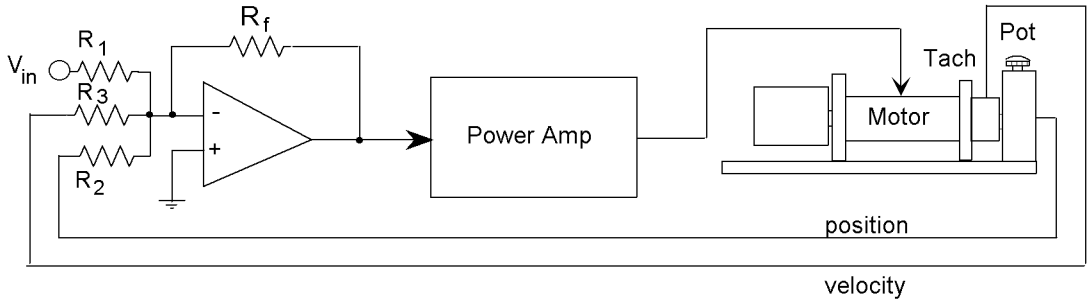
Laboratory 5: Design Exercise

Laboratory Objectives: To design and test a position control system to meet a set of performance specifications.

Introduction: In Laboratory 4 you constructed a closed-loop position controller with velocity feedback:



using an op-amp controller.



Use the above model to design an implement a position controller that will meet the following step-response performance criteria:

1. Peak overshoot of not more than 30%.
2. Peak time of less than 90 ms.

in the following steps:

Step 1: Design the control system (choose K and K_v) to meet the criteria.

Step 2: Use Matlab to verify that your design meets the performance specifications. (Hand

in you Matlab output).

Step 3: Implement your design using the op-amp controller you constructed for Lab 4. (We suggest you use $R_f = 200$ kΩ.)

Step 4: Record the step-response using input voltages corresponding to step angles of 30°, 60°, and 90°, and compare the plots to your Matlab simulation.

Step 5: Record the electrical power required by the motor during the transient response by monitoring the servo-amp output voltage and current (use the monitoring outputs), and using the *math* channel on the oscilloscope to compute and display the power. Determine the peak power requirement. Is it possible to significantly improve the response time of the lab system for a step size of 60°? What are the practical factors that limit the closed-loop performance?