

## Experiment #7

### The Characteristics of a Speed Control System: Load Compensation Performances of P and PI Controllers

#### 1. Preliminary Work

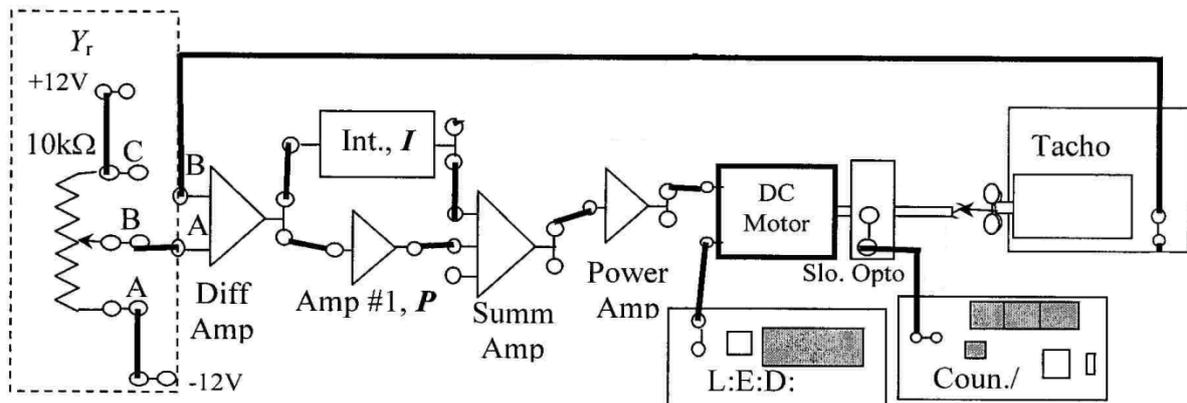
1.1 Give a brief description of proportional+integral (PI) control action. Write down the transfer function of a PI controller and define all terms and parameters involved.

1.2 Draw the block diagram representing the control system in the figure below.

Do not forget to include your references.

#### 2. Experimental Work

Connect the circuit in the figure.



#### 2.1 Open-loop Operation

Remove the feedback connection and the integrator from the circuit. Set the gain of amp. #1 to 1 and adjust the 10K resistor control for 10 rev/s motor speed. Load the motor by placing your finger under the Hall Effect disc. Does the motor easily stop? Measure and record the increase in motor current and voltage. Do they both increase? Repeat the procedure for the amp. #1 gain values 5 and 10 as well. Sketch the response (speed) versus time roughly.

#### 2.2. Closed-loop Operation: P Control Action

Connect the feedback loop connection. Set the amp#1 gain to 1. Adjust the motor speed as 10 rev/s. load the motor as in 2.1. Measure and record the increase in motor voltage and current. Do they both increase? Repeat the procedure for gain values 2 and 3. Note the effect of the

proportional gain on the response under load. Sketch the response (speed) versus time roughly.

### **2.3. Closed-loop Operation: PI Control Action.**

With the gain set to 1 and integrator time constant set to 1s. connect the integrator to the circuit as you press the reset button. Set the motor speed and load the motor as described above. Record the characteristics you observe. Repeat the procedure for  $T_i=10s$  and 100ms as well. Record the response and the time required to connect the response fro both cases. Sketch the response (speed) versus time roughly.

## **3. Results and Conclusions**

**3.1.** Sketch the rough characteristics for the proportional control action with three gain values used in 2.2. Comment on the effect of increasing the gian on the performance in load compensation.

**3.2.** Sketch the characteristics you have obtained in 2.1 to 2.3 on the same graph. Compare the performance of three operation modes when load is applied on the motor.

**3.3.** Summarise the properties of P and PI control actions illuminated by the results you obtained.