Experiment#8

PID Control Applied to a Positional System: Investigation of Step Responses

1. Preliminary Work

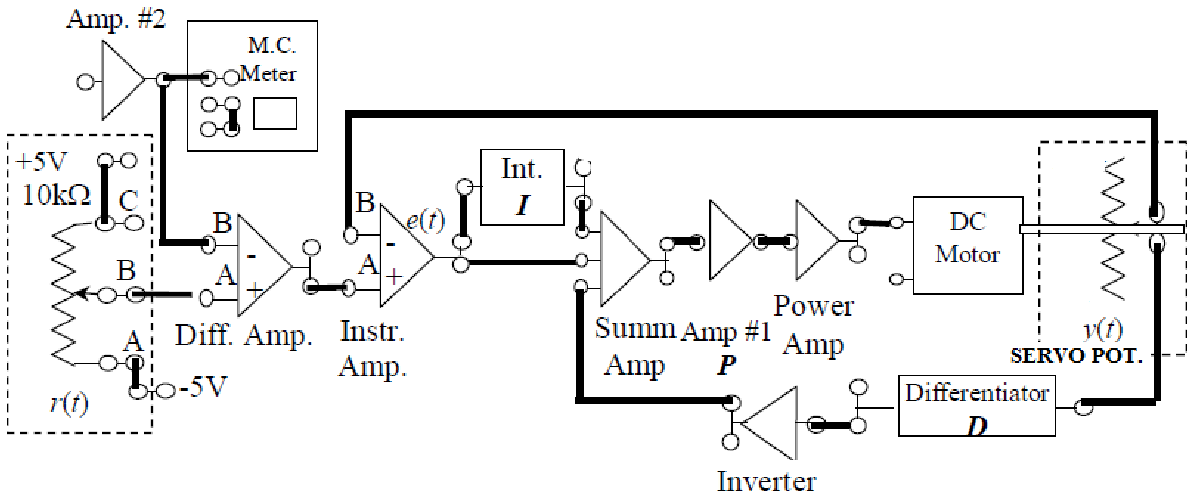
1.1. Give a brief description of proportional+integral+derivative (PID) control action. Write down the transfer function of a PID controller and define all terms and parameters involved.

1.2. Summarise the properties of P, PI, and PID controllers as far as steady-state error and stability are concerned.

Do not forget to include a list of your references!

2. Experimental Work

Connect the circuit in the figure



2.1. Set amp#1 gain controls to 10 and 1.0 and adjust the input so that the output is 30 degrees. And then return the fine gain 0.1. adjust amp#2 offset in order get 3V for coarse gian 100 and approximately zero for coarse gain 1.

2.2. P Control: Disconnect the integrator and differentiator from the circuit. Set the amp#1 gain to 1. Change the coarse gain of amp#2 from 1 to 100 and note the effect on the outut shaft position. Note the steady-state error, overshhot and oscillatory behaviour of the response if any. Sketch the response (shaft position) versus time rougly. Repeat the procedure for amp#1 gain values of 5 and 10, as well.

2.3. PI Control: With the gain set to 1 and integrator time constant to 1s. connect the integrator to the circuit as you press the reset button. Note the steady-state error, overshoot and oscillatory behaviour of the response if any. Sketch the response of the shaft position versus time rougly. Record the characteristic you observe. Repeat the procedure for gain values of 5 and 10 as well. Then, for the gain value of 5, repeat the procedure for Ti=10s and Ti=100 ms in order to see the effect of variation of integration time constant.

2.4. PD Control: Disconnect the integrator from the circuit and connect the derivative output from the inverter to the summing amp. with amp#1 gain 10, set the diff. Time constant to 1s and repeat procedure in 2.2 and 2.3. record the response and results for differentiator time constant set to 100ms and 10 ms, as well.

2.5. PID Control: With the gian set to 1, connect the integrator to the circuit as you press the reset button. Observe the step response for all possible combinations of integrator and differentiaotr time constants. Choose the best combination which gives the optimum response with small overshoot.

3. Results and Conclusions

3.1. Commnet on the resluts you have obtained for P, PI, PD, PID contrl. How do the proportional gain, integrator time constant, and differantiator time constant affect the steady-state error, maximum overshoot, and oscillatory on the response?

3.2. Propose a method to obtian a PID controller without using the differentitor circuit in the sytem.