EE380 (Control Systems)
Lab work of Experiment 9
(modified version of Experiment 4)

Student Name	Roll No.	Bench No.

Verify that in your experimental setup the lead from the sensing resistor R_s is connected to CN4 input pin 1 as shown in Figure 5.3 of the lab manual, in addition to the usual connections for speed control.

Uncomment the following parts of `main-prog.c`

```
//  IV = AD_value();  // Read voltage across Rs=4.7ohm.
//  IV = 5*(511 + IV)/1022; // Convert signed to unsigned.
```

and

```
//  Is = IV/4.7;      // Convert voltage to current.
//  IF = (1-5.0*T)*IF + 5.0*T*Is; // Low-pass filter.
```

There are other parts of `main-prog.c` that you will uncomment at your discretion.

Q5 Write a code to apply a step input to the motor. Run the setup in OL mode. Identify the system parameters K_m and τ_m by using the OL step response. **[$\sim$ 10 min]**

Q6 If K_m and τ_m are different from those you saw in Experiment 1, calculate the values of R_Σ and B as you did in Q1. Use the Matlab code of Q1 for this calculation. **[$\sim$ 5 min]**

Q7 Use the controller from Experiment 1. Control the motor using feedback of speed. Sketch ω versus t and u vs. t in the table provided. Use $\omega_{\text{ref}} = 100$ rad/s in Q7, Q9, Q12. **[$\sim$ 10 min]**

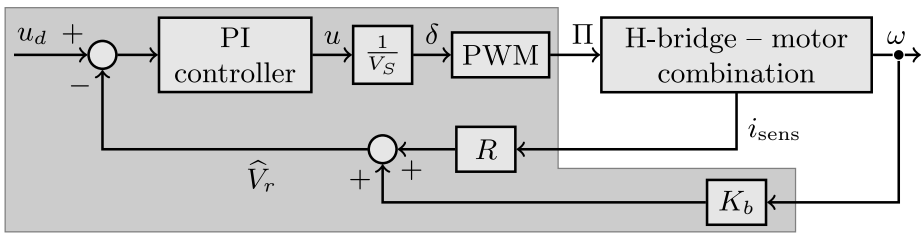
Q8 Use the controller from Experiment 1. Control the motor using feedback of current with $\widehat{\omega} = \frac{u - R_\Sigma i}{K_b}$. Sketch ω vs. t, $\widehat{\omega}$ vs. t, and u vs. t in the table provided. **[$\sim$ 15 min]**

Q9 Answer the following questions: **[$\sim$ 10 min]**

Q9.1 . Why are the steady state values of ω in Q7 and in Q8 not the same?

Q9.2 Why are the steady state values of ω and $\widehat{\omega}$ not equal in Q8?

Q10 Burn the C-file `main-prog-exp9.c` into the μC. Take care to modify the value of R. This file implements the following block diagram and returns the data for u_d and u. Record this data into a log file using `terminal.exe`. **[$\sim$ 10 min]**

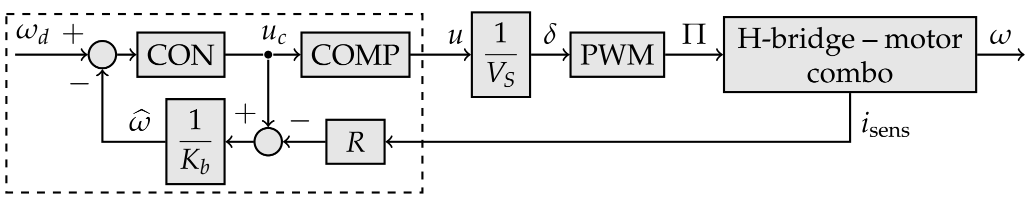


Q11 Use the m-file `readplot_exp9.m` to process the data given out by `main-prog-exp9.c`. **[$\sim$ 10 min]**

Q11.1 Write down the polynomial generated by the m-file.

Q11.2 Sketch the compensator generated by this m-file in the below space.

Q12 Insert the compensator polynomial at the appropriate place in `main-prog.c` and repeat Q8. Sketch ω vs. t, $\widehat{\omega}$ vs. t, and u_c vs. t in the table provided. **[$\sim$ 20 min]**



Q13 Do you think that the polynomial given out by `readplot_exp9.m` is a good compensator for the nonlinearities introduced by the H-bridge? **[$\sim$ 1 min]**

Q	Var	Plot
Q7	ω	
Q7	u	

Q	Var	Plot
Q8	ω	
Q8	$\widehat{\omega}$	
Q8	u	

Q	Var	Plot
Q12	ω	
Q12	$\widehat{\omega}$	
Q12	u	