Laboratory Three

0.1. A DC motor model is given by the transfer function

$$G(s) = \frac{0.5}{(s+2)s} \tag{0.1}$$

where the input is voltage and the output is the angular position. The requirement is that the angular position follows a ramp signal of a unit slope without steady-state error, and the operational requirements are that the control signal is within the limits of $(-7, 5)$, and the derivative of the control signal is within the limits of ± 20. The desired closed-loop performance is determined using the desired closed-loop polynomial $(s^2 + 2\xi w_n s + w_n^2)(s + \lambda_1)^2$, where $\xi = 0.707$ and $w_n = \lambda_1 = 3$.

1. Design a PID controller for this system.
2. Discretize the PID controller based on velocity form.
3. Write Simulink real-time function for PID controller in velocity form together with anti-windup mechanisms;
4. Implement the PID controller using Simulink programs with the real-time function.

0.2. For the same system, investigate the approach that uses a smaller controller gain to reduce both $|u(t)|$ and $|\dot{u}(t)|$ so that these signals are within the operational limits and compare the results with the anti-windup control.