

EE311FZ Project 2

Due 14th Dec.

Hand-written submissions will NOT be accepted. The project contributes to 15% of the overall module grade. Write a report based on the following questions. You are recommended to write explanations for each step.

1. System defined in transfer function form

$$G(s) = \frac{2.3(s + 18)}{(s + 1)(s + 5)(s + 8)}$$

Performance specs

- Settling time $T_s = 0.9$
 - Peak Overshoot (PO) $\leq 10\%$
 - Control signal limits, $-24 \leq u \leq 24$
2. Determine a state-space description for the system (controllable canonical form)
 3. Specification of a set of performance criteria:
 - Transient performance specifications
 - Limits on the control signal
 4. Design the following controllers to achieve the required design specifications:
 - PID controller (Open-loop Z-N, closed-loop Z-N, performance index (ITAE), manual)
 - State-feedback control-oriented model setup, which permits a non-zero state/output setpoint.
 - State feedback controller design. (You may not assume that the states of the system are measurable, so a state estimator must be designed. As a guideline, the poles of the state estimator should be chosen to be twice as fast as the closed-loop (control) poles.)
 5. Verify, using a time-domain Simulink simulation, what performance is achieved by each of your controllers. You should plot the step response variations, along with the setpoint and control signal and calculate:
 - The actual response settling time
 - The actual % Peak Overshoot
 - The maximum value of the control signal
 - The steady-state error
 6. Comment on the various controllers designed, in terms of:
 - The type of specifications achievable
 - The tracking performance obtained (e.g. steady-state error, peak overshoot, ..)
 - The transient response
 - The size of the control signals