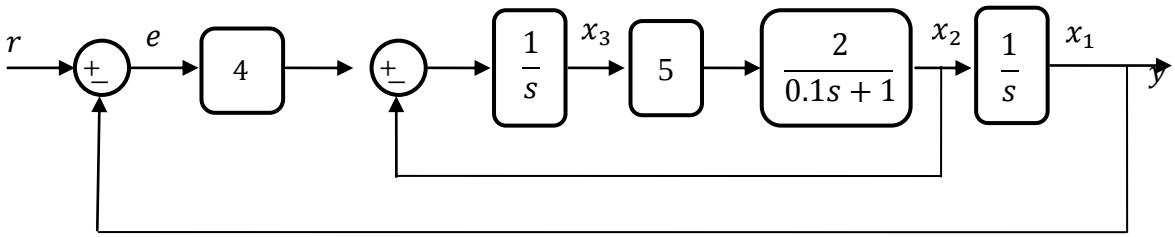
EE 302 – Assignment #3

Given: March 28, 2019; Deadline: April 10, 2019 15:40

There will be a box to drop the assignments in front of D-226. The box will be removed after 15:40.

Q1. Consider the system below given in block diagram form.



(a) Derive the steady-state error for a unit-step reference input,
(b) Derive the steady-state error for a unit-ramp input,
(c) What is the "Type" of the system? Justify your answer.
(d) Suppose x_1, x_2 and x_3 are defined as the "states" of the system. Obtain the state-space representation for this system.
(e) Implement this system in Matlab-Simulink. Simulate for unit-step and unit-ramp reference inputs. Provide the response plots and verify your results in (a) and (b).

Q2. Consider the open-loop "plant" given by the transfer function

$$G(s) = \frac{1}{s(s+1)(s+2)}$$

The system is to be controlled by a "Proportional" P-controller in a unity negative feedback configuration.

(a) Sketch the block diagram of the overall system,
(b) Determine the full range of K (K>0 as well as K<0) for the closed-loop system to be stable. For what value of K is the system *critically stable*?

Q3. Consider again the system described in Q2. Sketch the Root-Locus of the closed-loop system for all values of K>0. Obtain all relevant information and mark on your sketch.

Q4. Consider the unity negative feedback system below. Plot the root-locus as the design parameter α is varied $\alpha: 0 \rightarrow \infty$. Determine the value of α such that the dominant closed-loop poles gives us a damping ratio of 0.5.