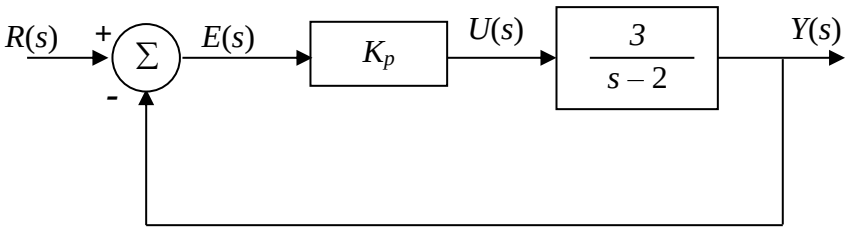
Tutorial Sheet 6 – Control

(Covering section 9 of the notes)

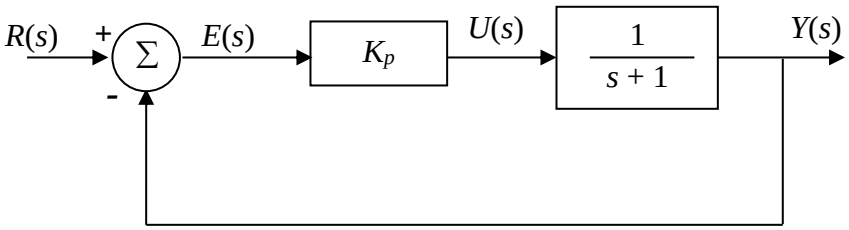
Q1 Compare and contrast on/off, proportional and PID control.

Q2 Explain what is meant by the term *differential gap* in the context of on/off control.

Q3 Consider the following closed-loop control system. Determine a suitable value for the controller K_p such that controlled system produces a stable response.



Q4 Consider the following closed-loop control system. Determine a suitable value for the controller K_p such that controlled system produces a 2% settling time of exactly 1s. *Note that a first order system settles after 4 time constants*.

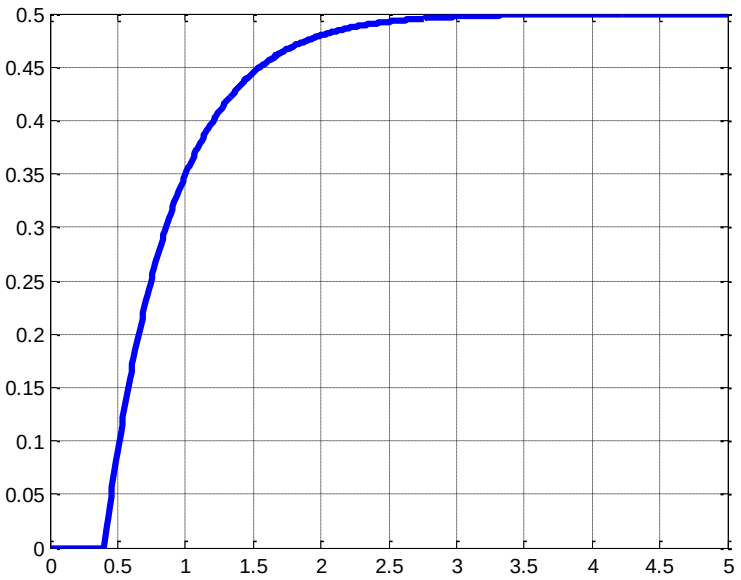


Q5 (i) Determine, as a function of K_p, the steady-state error (difference between actual output and desired output) of the system in Q4 above for a unit step input.

(ii) Can the steady state error be eliminated? Justify your answer.

(iii) How does a PID controller solve this problem?

Q6 The following graph represents the open-loop step response for a controlled water tank system with a 0.4s measurement delay. Using the Ziegler-Nichols tuning rules (method 2), derive a PID controller for this system.



Q7 Given that an arbitrary closed-loop system oscillates as shown in the figure below, when the proportional controller in the forward path is set to a gain value of 3, use the Ziegler-Nichols tuning rules (method 1) to determine a suitable PID controller for this system.