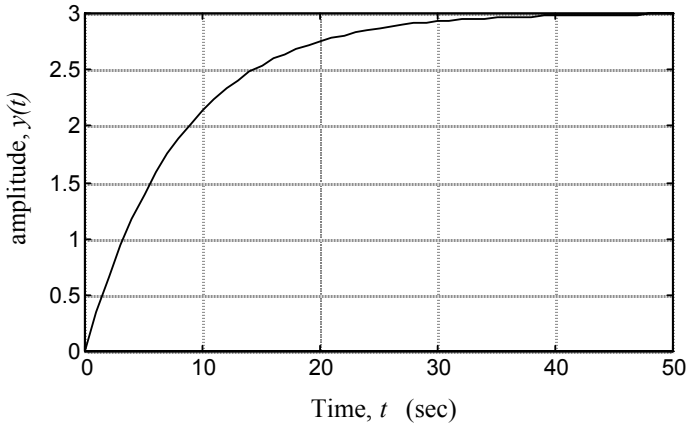
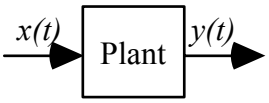
1.) A plant has the response, *y(t)*, to a unit step, *x(t) = u(t)* as shown below.





(15 pts) a) Estimate the system's time constant, 2% settling time and steady state gain. (Write results in boxes below)

Time Constant (sec) | 2% Settling Time | Steady-State Gain

(5 pts) b) What is the minimum order is the system transfer function based on the characteristics of the time response? (Write your result in the box provided)

Minimum System Order

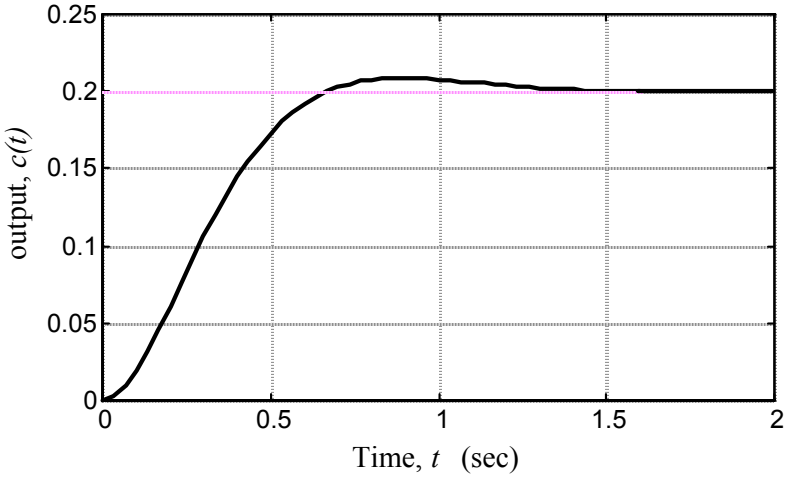
(5 pts) c) For a system model of the minimum order in part b), Find the transfer function *G(s) = Y(s)/X(s)* (Write your result in the box provided)

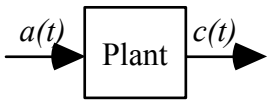
G(s) =

Transfer Function

_____/25

2.) A plant has the response, *c(t)*, to a unit step, *a(t) = u(t)* as shown below.





(15 pts) a) Estimate the system's time constant, 2% settling time, % overshoot and steady state gain. (Write results in boxes below)

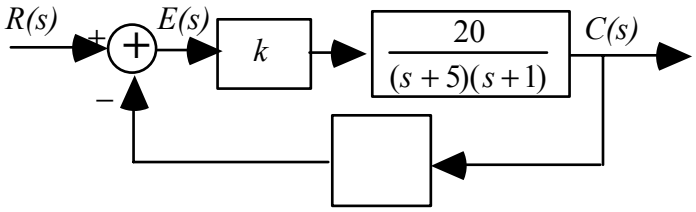
Time Constant (sec) % Overshoot Steady-State Gain

(10 pts) b) Estimate the system's damped natural frequency and damping ratio.

Damped Natural Freq (rad/sec) Damping Ratio

_____/25

3. For the controlled plant with Proportional controller shown below,



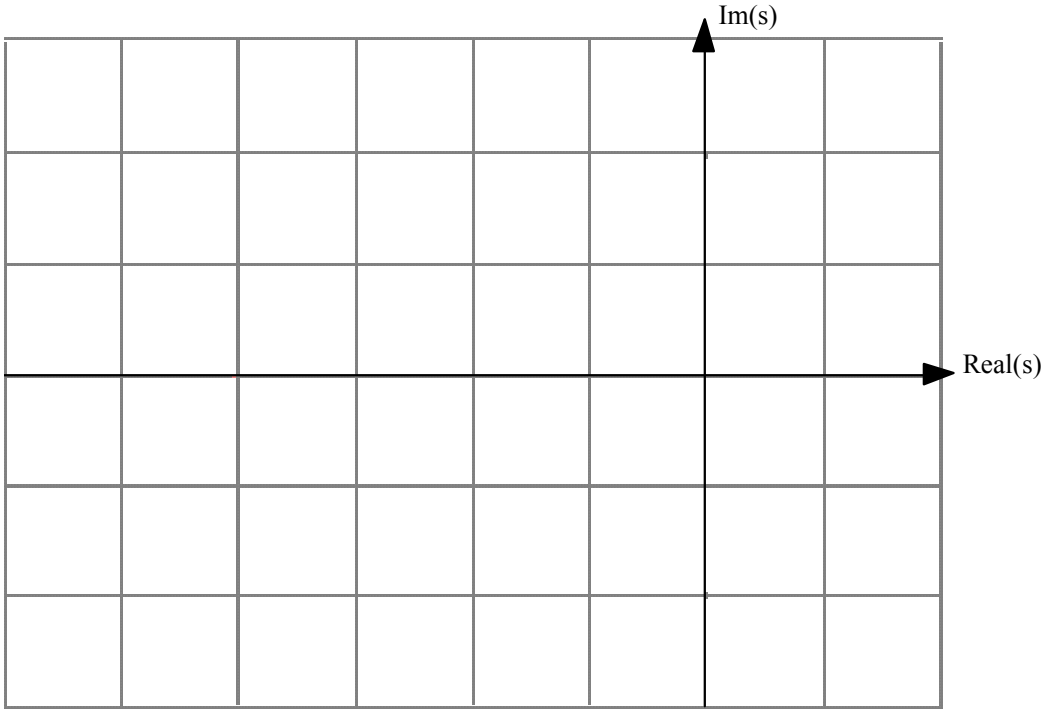
(5 pts) a) What is the closed-loop system characteristic polynomial?

Closed-Loop Characteristic Polynomial

(10 pts) b) For what range of gain k is the system stable?

Range of stable gain k

(10 pts) c) Draw the root locus for $k \geq 0$ noting were possible, range of stable gain, breakaway/breakin points, angles of departure/arrival, asymptotes, etc.



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4. A designer proposes a modified controller and sensor system with the open-loop transfer function

$$kG(s)H(s) = k\frac{(s+3)}{s(s+5)(s+1)}$$

(10 pts) a) For what range of gain k is the modified system stable?

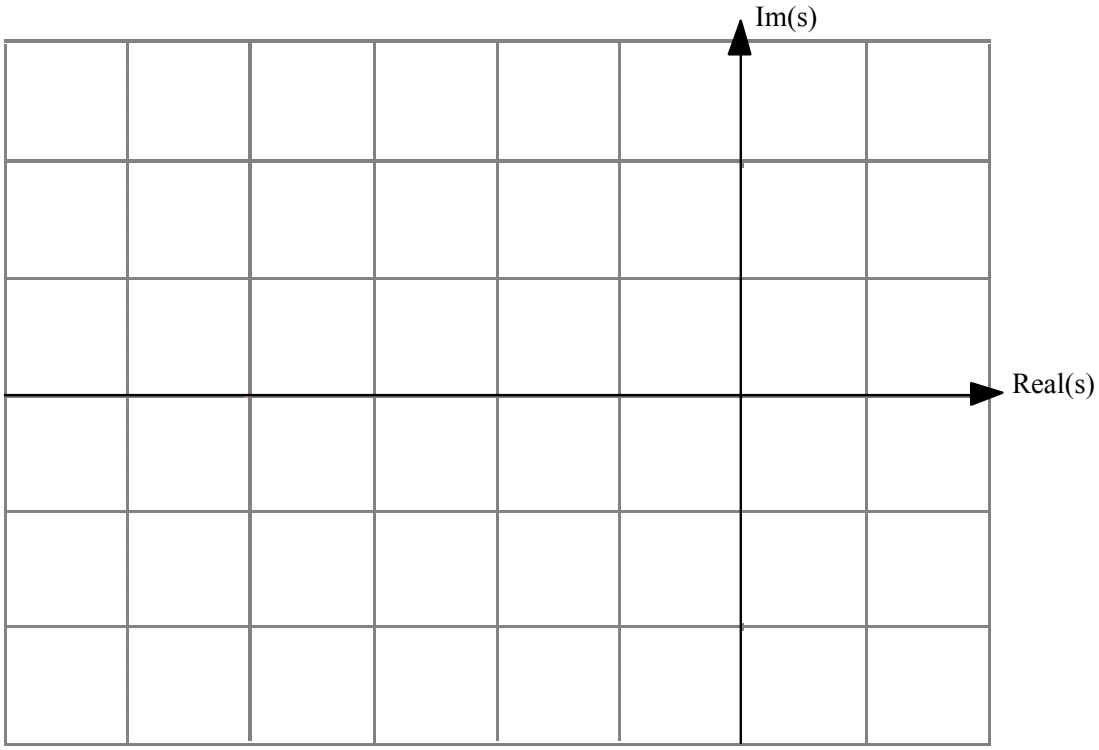
Range of stable gain k

(5 pts) b) What is the closed-loop system steady-state error at maximum stable gain?

$e(\infty) =$

Closed-Loop System Steady-State Error at Maximim Stable Gain

(10 pts) c) On the axes below, sketch the root locus for $k \geq 0$ noting were possible, range of stable gain, breakaway/breakin points, angles of departure/arrival, asymptotes, etc.



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