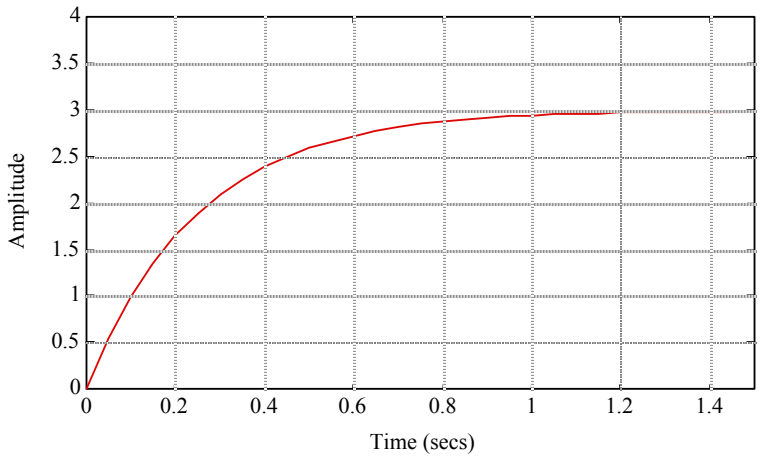
1.) Given a system with the response, c(t), to a unit step, u(t) shown in the graph below,



(5pts) a) Find the system's time constant. (Write your result in the box provided)

Time Constant (sec)

(5 pts) b) Find the 2% settling time. (Write your result in the box provided)

2% Settling Time (sec)

(5 pts) c) What is the steady-state gain of this system based on the unit step input?

Steady-State Gain

(5 pts) d) 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

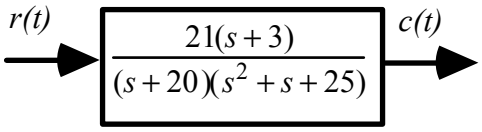
(5 pts) e) For a system model of the minimum order in part d), Find the transfer function, $C(s)/U(s)$, between the second state variable, *ct)*, and the input, *u(t)*. (Write your result in the box provided)

$$\frac{C(s)}{U(s)} =$$

Transfer Function

_____/25

2. For the system in the block diagram below,



(5 pts) a) If $r(t) = 3u(t)$, find the steady state value, $c(\infty) = \lim_{t\to\infty}[c(t)]$.

$c(\infty) =$

(5 pts) b) The longest lasting component of the system response is due to which term in the system transfer function?

Longest LastingTerm

(5 pts) b) At approximately what frequency would you expect any oscillatory components of the system response to occur?

(rad/sec)

Oscillation Frequency

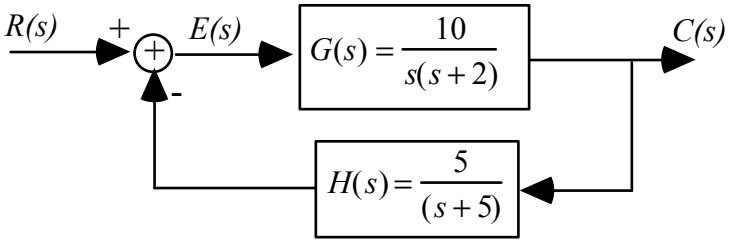
3. For each characteristic equation below, determine the stable range of the parameter, K.

(5 pts) a) $s^3 + 2s^2 + Ks + 10 = 0$

(5 pts) b) $s^4 + 2s^3 + 2s^2 + Ks = 0$

_____/25

4. For the system shown below,



Compute the steady-state error for each input, r(t) given below.

(10 pts) a) Compute the steady state actuating error, e(t) for an input unit step, *r(t) = u(t)* such that *R(s) = 1/s*

Step error =

(10 pts) b) Compute the steady state actuating error, e(t) for an input unit ramp, *r(t) = t u(t)* such that $R(s) = 1/s^2$

Ramp error =

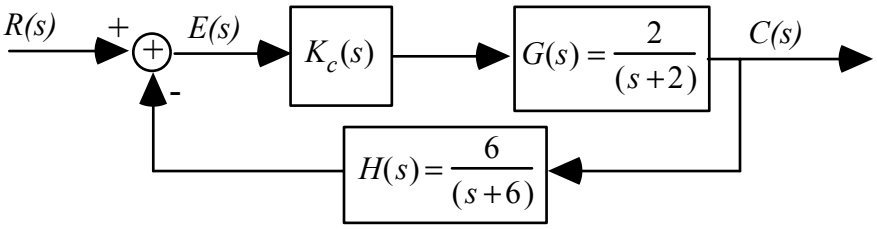
(5 pts) c) Errors in the output, C(s) are most sensitive to variations in which transfer function,

G(s) or *H(s)* ? (Choose one)

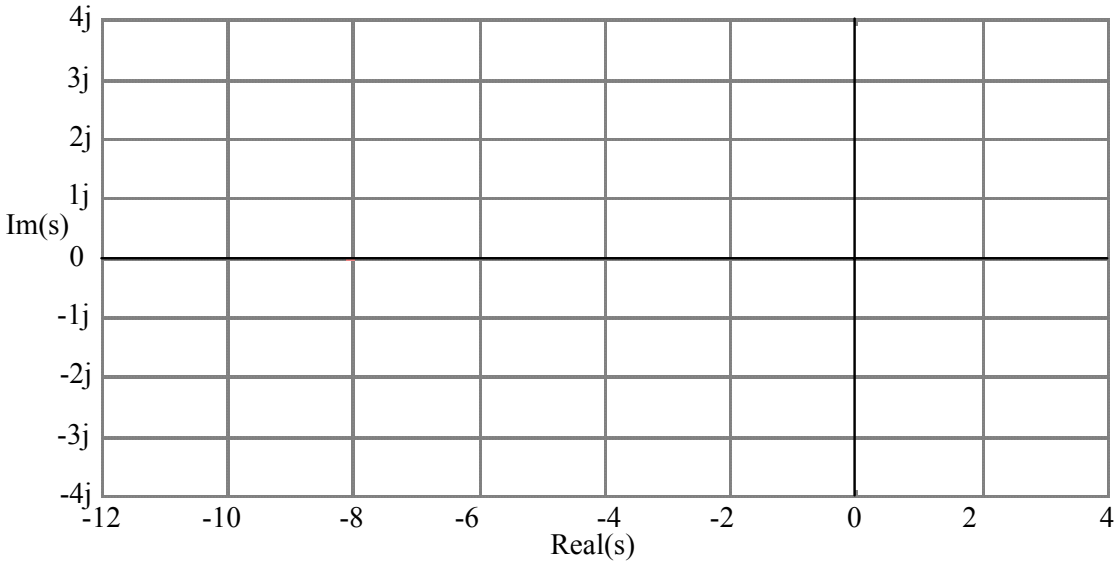
G(s) or *H(s)*

_____/25

6. For the system shown below,

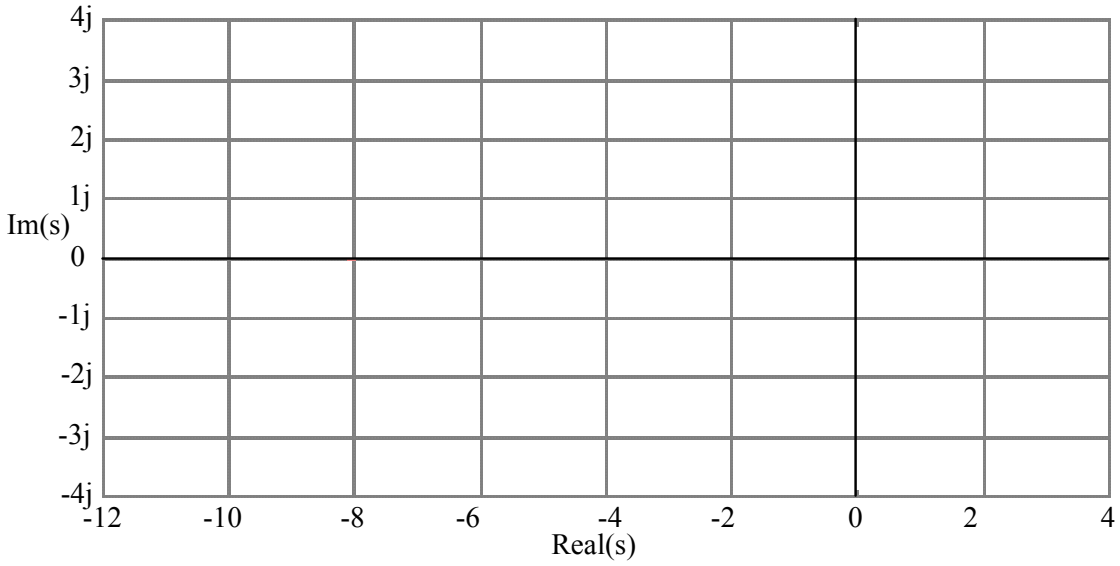


(10 pts) a)Draw the root locus for proportional control, $K_c(s) = K_P$ noting were possible, range of stable gain, breakaway/breakin points, angles of departure/arrival, asymptotes, etc.



_____/10

(15 pts) 6(b) Draw the root locus for integral control, $K_c(s) = K_I/s$ noting were possible, range of stable gain, breakaway/breakin points, angles of departure/arrival, asymptotes, etc.



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