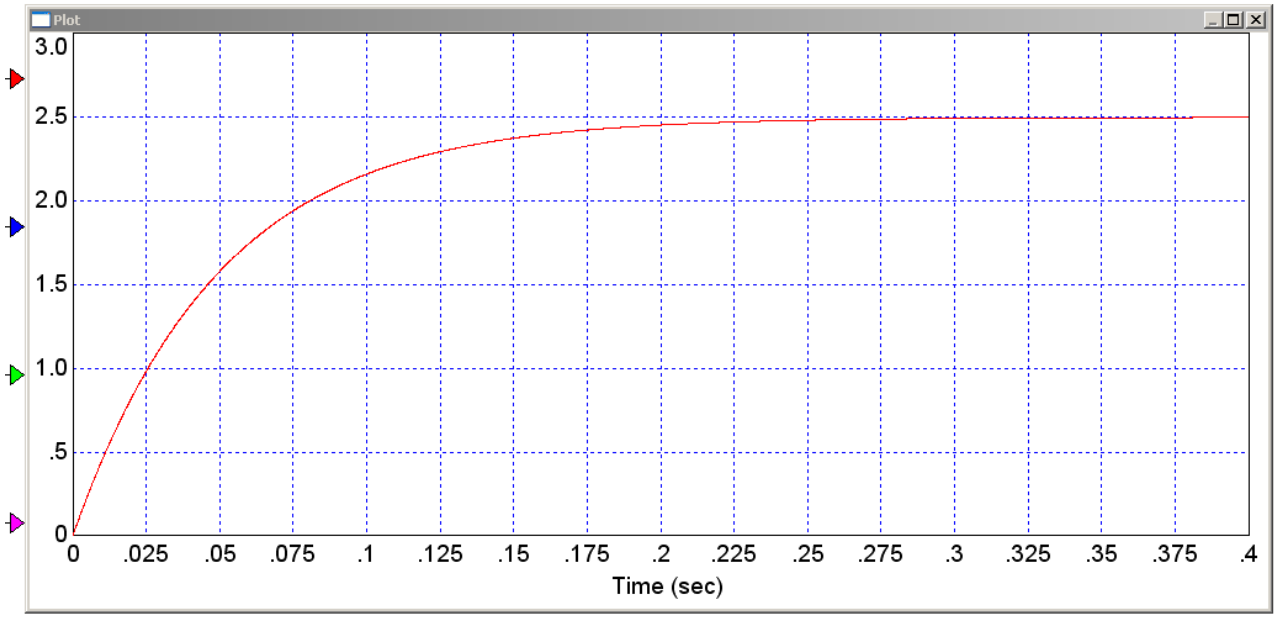
ECE461 - Sample Qualifyint Exam

Phasors and LaPlace Transforms:

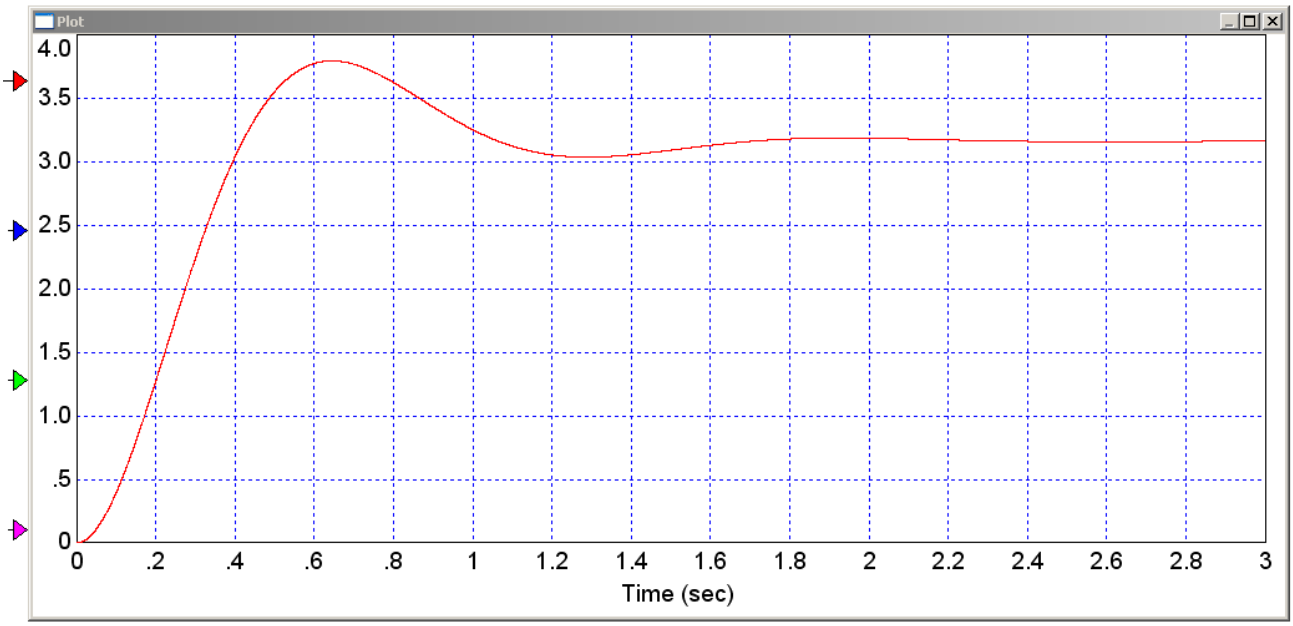
1) The transfer function for a dynamic system is $Y = \left(\frac{16}{(s+1)(s+3)(s+5)(s+8)} \right) X$

- What is the differential equation relating X and Y?
- Find y(t) if x(t) = 2 + 3cos(10t)
- Find y(t) if $x(t) = \begin{cases} 0 & t < 0 \\ 2 & t > 0 \end{cases}$

2) The step response of a dynamic system for a 1Volt input is as follows. Determine the transfer funciton



3) The step response of a dynamic system for a 1Volt input is as follows. Determine the transfer funciton



Root Locus

4) Sketch the root locus for 0 < k < infinity:

$$(s+1)(s+3)(s+5)(s+8)+16k=0$$

Include the following:

- real axis loci
- # asymptotes
- asymptote angles
- asymptote intersect
- jw crossings
- breakaway point(s) (approximate)

5) For

$$G(s)=\left(\frac{16}{(s+1)(s+2)(s+5)}\right)X$$

design a compensator, K(s), which results in a unity feedback system having the following properties:

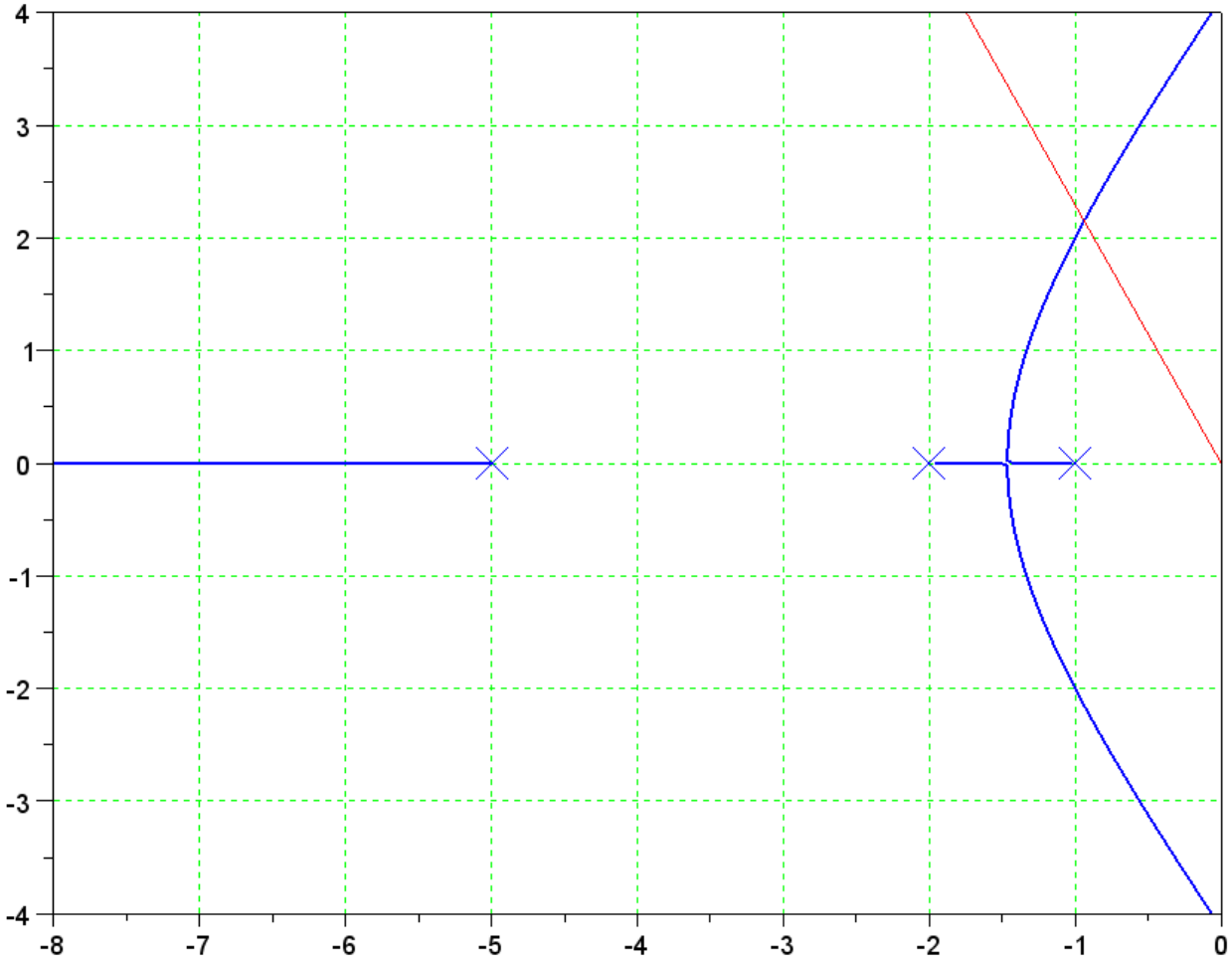
- No error for a unit step input
- 2% settling time = 1.5 seconds
- Damping ratio = 0.4

6) The root locus of

$$G(s) = \left(\frac{16}{(s+1)(s+2)(s+5)}\right) X$$

is shown below.

- Design a gain compensator, K(s) = k, for a unity feedback system so that the closed loop system has a damping ratio of 0.4.
- For this valus of k, sketch the resulting closed-loop system's step response



7) Design a circuit to implement the following compensator:

$$K(s) = \left(\frac{100(s+2)(s+5)}{s(s+20)}\right)$$