Name ______________________________ Section _______________________

ES205

Examination III

May 15, 1998

Problem	Score
1	/30
2	/20
3	/25
4	/25
Total	/100

Show all work for credit

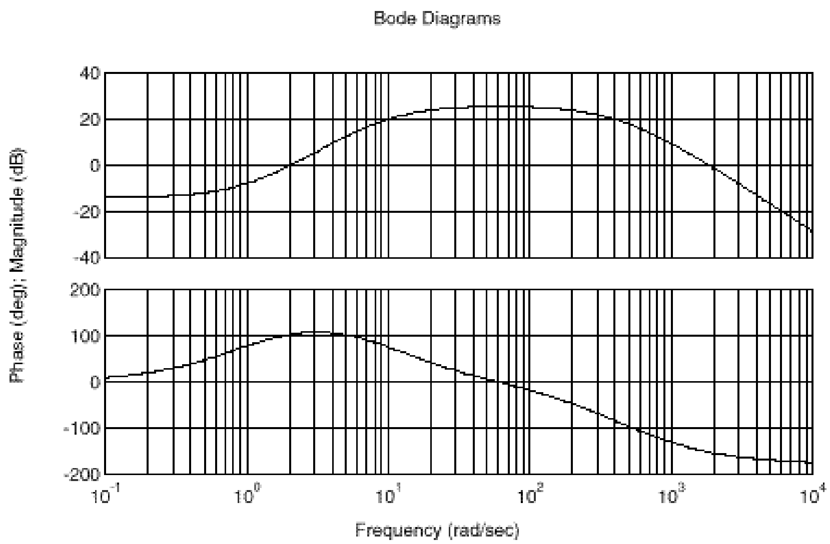
AND

Turn in your signed help sheet

Name ___________________________________ 30 pts

ES205 Examination III **Problem 1** May 12 1998

Problem 1a-1d) The frequency response plots for a physical system are shown below answer the following questions.



1a) For what range of frequencies will the output be larger than the input?

1b) At what frequency will the steady state output be smallest?

1c) For what frequencies will the output lead the input?

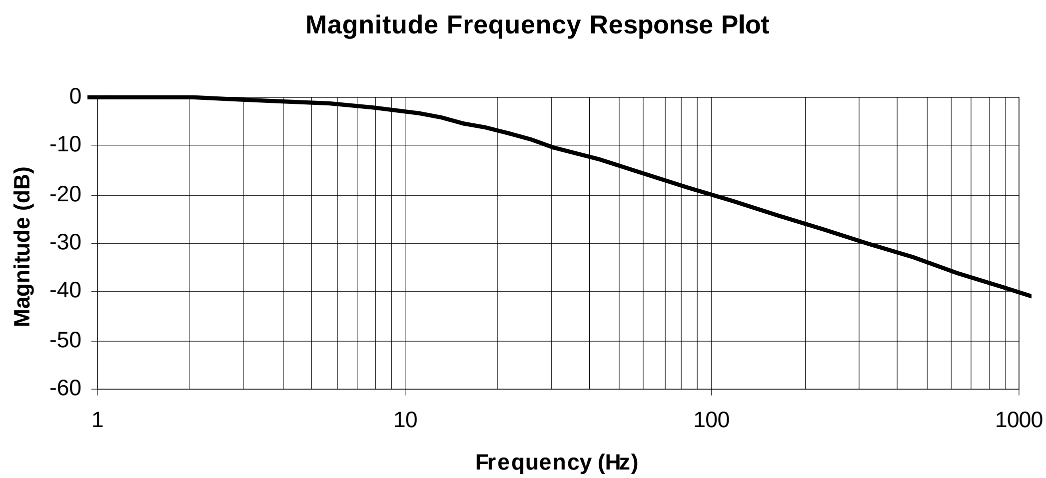
1d) If the system is forced with f(t) = 10cos(1000t) what is the steady state output?

Problem 1e)

When sketching the straight line asymptotic frequency response plots the first step it to factor the numerator and denominator into first order terms (real roots) and second order terms (complex roots). Why?

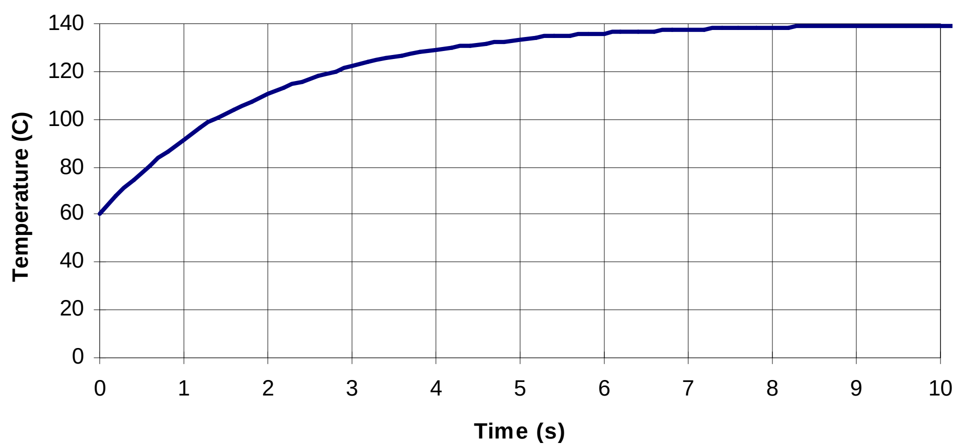
Problem 1f-1g) The magnitude frequency response plot for a first order system is shown below. If a low pass filter is placed before this system with the transfer function $TF(s) = \frac{1}{\frac{s}{100}+1}$

1f) Sketch the new magnitude frequency response plot. Use the semilog paper shown below and just overlay the new plot.

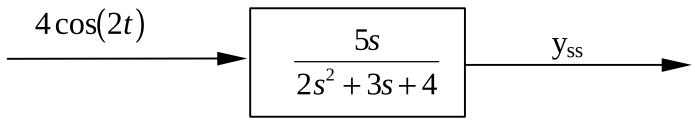


1g) What would you expect the phase to be for very large frequencies after the filter is added?

Problem 1h) The step response of a first order system is shown below. What is the time constant?



Problem 1i) Determine the steady state response, y_{ss}, for the system shown using the transfer function approach.



Problem 1j) When running simulink from an mfile the format is:

sim('X',[Y Z])

what is X?

what is Y?

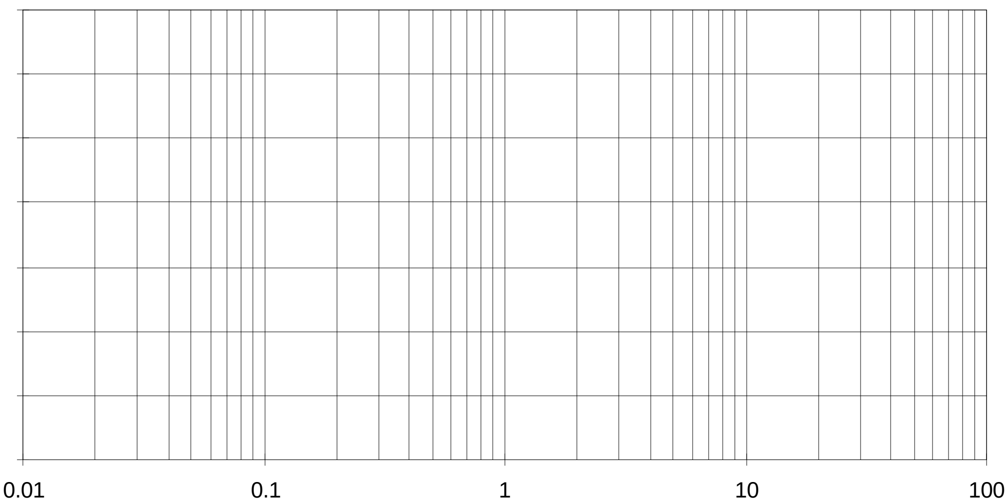
what is Z?

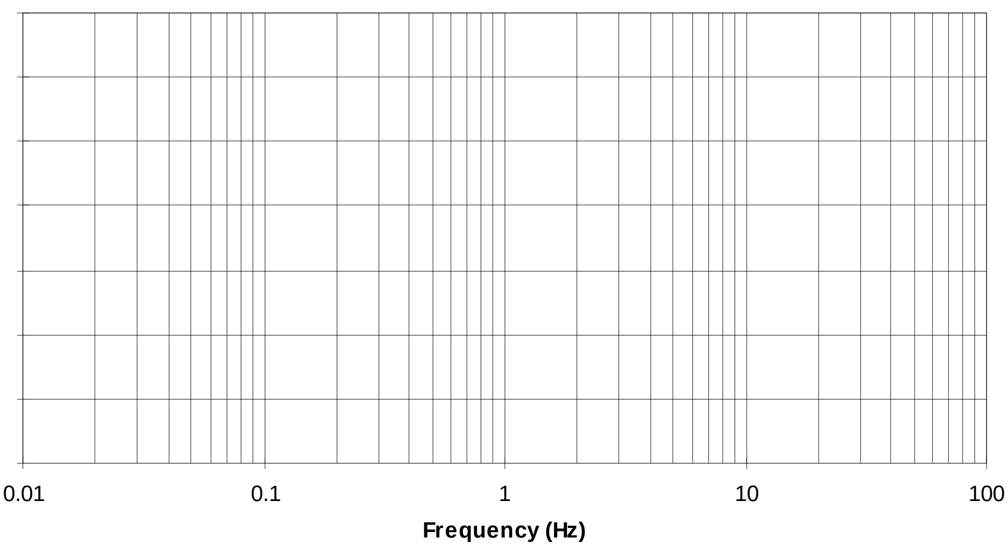
Name ___________________________________ 20 pts

ES205 Examination III **Problem 2** May 12, 1998

Sketch the straight line asymptotic frequency response plots for the following transfer function. Use the semilog paper given below for this purpose.

$$TF(s) = \frac{s^2 + 3s + 2}{2(s+1)(s+0.1)}$$





Name ___________________________________ 25 pts

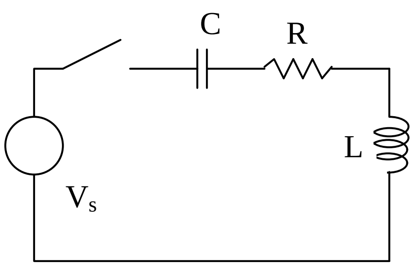
ES205 Examination III **Problem 3** May 12, 1998

We wish to determine the parameters of a circuit be studying its transient response to a known input. For the circuit shown the source voltage is V_s and at t=0, the switch closes. The voltage across the known resistor (R=100 Ω) is measured and is shown below. The equation of motion is provided for you below.

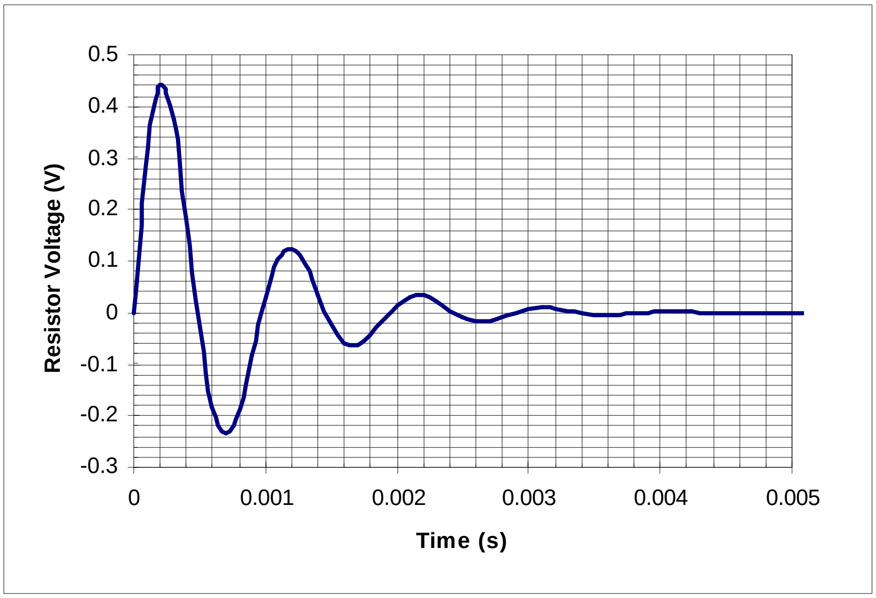
$$LC\frac{d^2i}{dt^2} + RC\frac{di}{dt} + i = 0$$

Determine the values for the inductance and capacitance.

Circuit:



Time Response



Name ___________________________________ 25 pts

ES205 Examination III **Problem 4** May 12, 1998

Consider a spring scale, in which the weighing platform is supported on a spring and lubricated piston as shown below. Assume the equivalent translating mass M of the system is 4 kg when there is nothing on the scale. You have been hired to determine the spring stiffness, K, and the damping coefficient, C, such that the system meets the following performance specifications when a mass m=2 kg is placed on the scale. The equation of motion, for x measured from the original static equilibrium point of the scale, is given below for convenience.

$$(m+M)\ddot{x}+C\dot{x}+Kx=mg$$

Required Performance Specifications:

- The percent overshoot should be less that 20%
- The time to first peak should be less than 0.4 seconds
- The time to steady state (2% settling time) should be less than 2 seconds
- The spring stiffness should be as small as possible to maximize the final steady state displacement of the scale (i.e. better resolution)