ME-221
PROBLEM SET 10

Problem 1

Consider the system described by the following transfer function:

$$G(s) = \frac{10 + s}{2s^2 + 4s + 1}$$

a) Determine the amplitude ratio between the unit step input and the corresponding output signal at the steady state.

b) Determine the steady-state output for an input given by $u(t) = 5sin(\pi t)$.

Problem 2

Consider the system described by the following transfer function:

$$G(s) = \frac{12}{(s + 4)(5s + 1)}$$

a) Sketch the Bode plot of this system.

b) Determine the magnitude and phase angle for $\omega = 2$ rad/sec.

Problem 3

Find the transfer function of a system with steady-state gain of 2, a pole at -2 and a zero at $-1/b$ where b is a scalar value. Sketch the Bode plot for $b = 0.1$.

Problem 4

Sketch the Bode plot of the following transfer function. Determine the impulse response of the system.

$$G(s) = \frac{A}{s^2(\tau s + 1)}$$

Problem 5

Consider the system described by the log-magnitude curve shown in Figure 1.

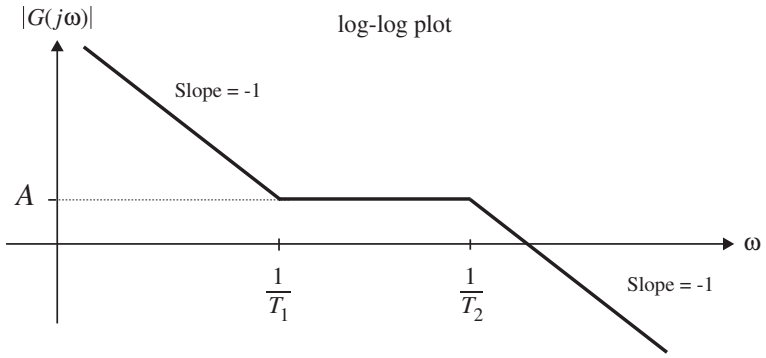

Figure 1: Asymptotes of the Bode magnitude plot

a) Determine the transfer function of the system.

b) Calculate the impulse response.

c) Sketch the Bode phase plot.

Problem 6

The model of a mechanical system is given by:

$$10\ddot{y} + c\dot{y} + 20y = u(t)$$

How large must the damping constant c be so that the maximum steady state amplitude of y is no greater than 3, when the input is $u(t) = 11sin(\omega t)$, for an arbitrary value of ω?